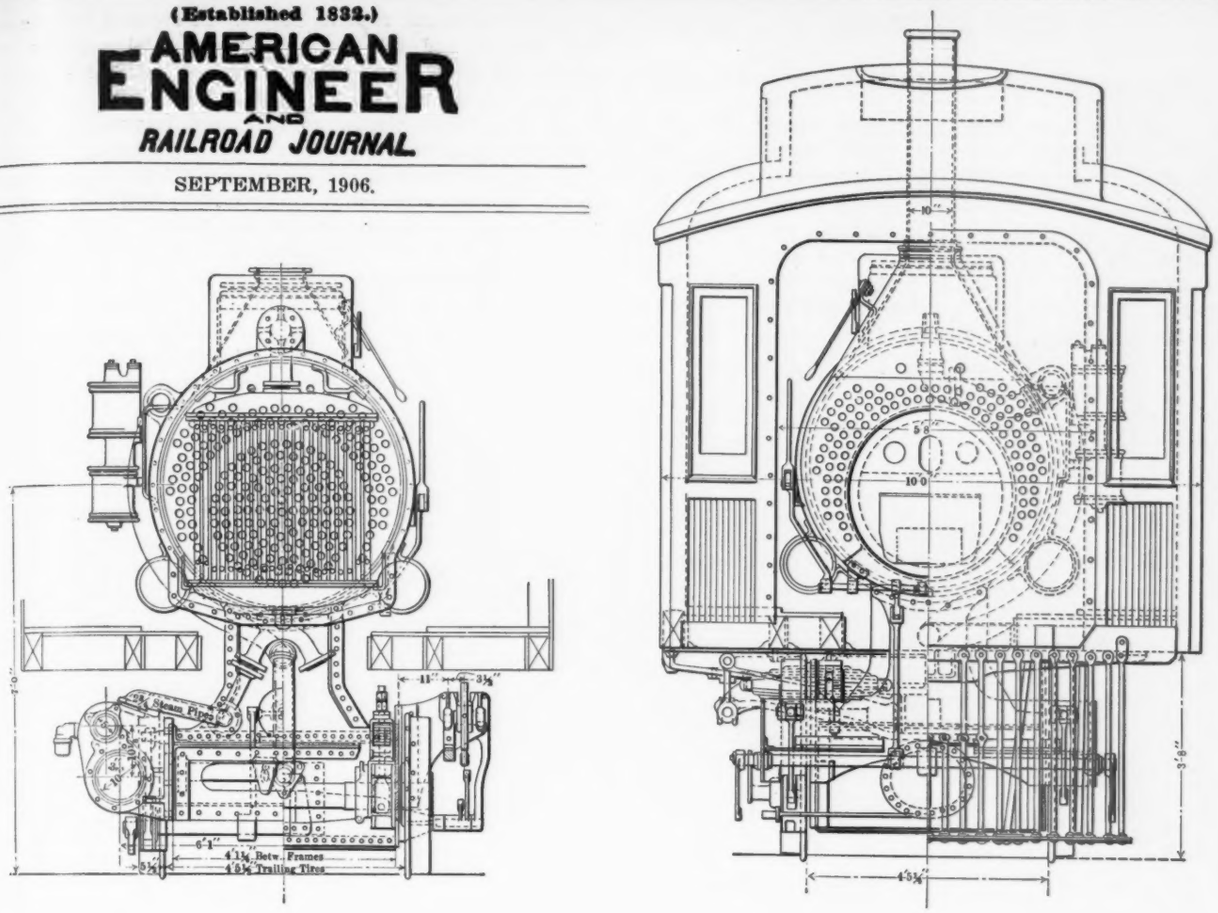
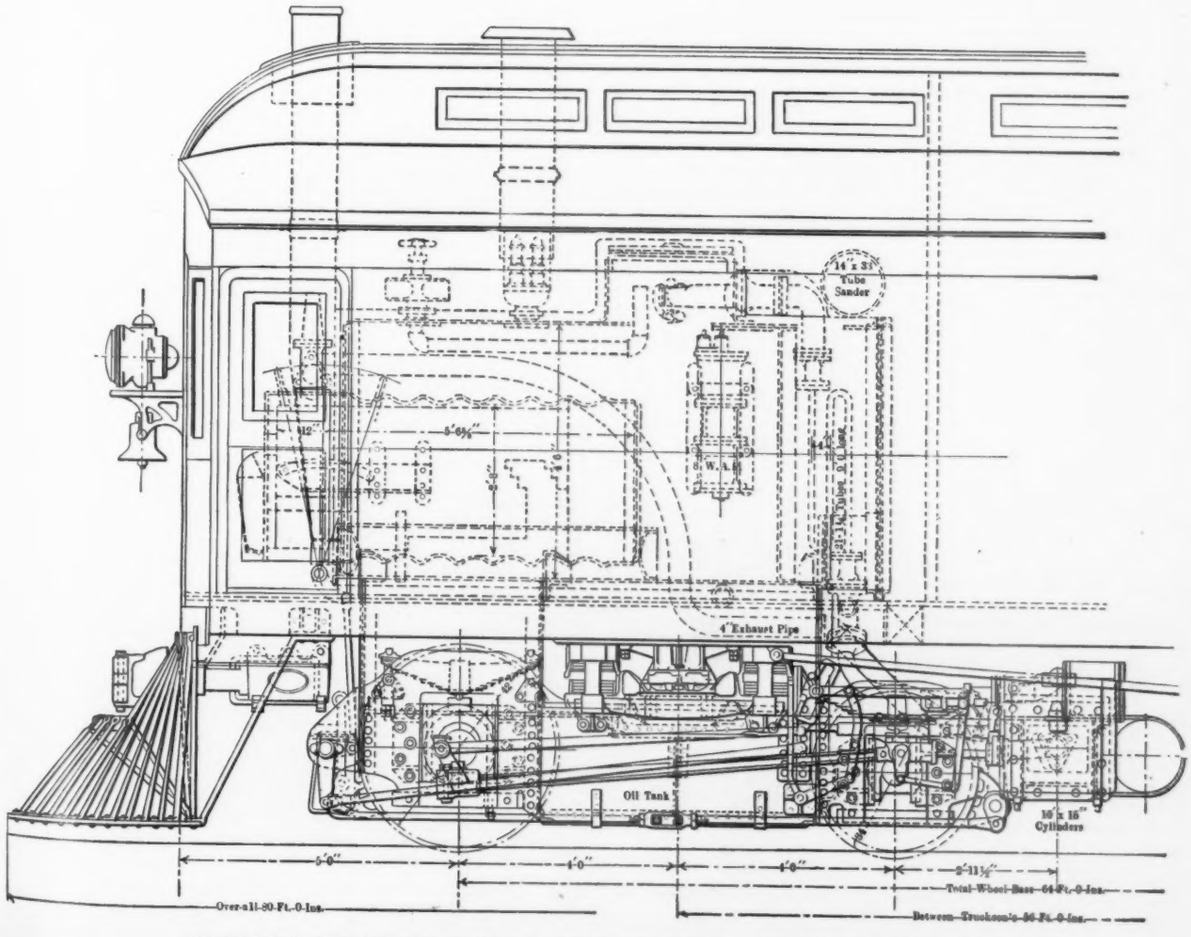
(Established 1832.)
AMERICAN ENGINEER AND RAILROAD JOURNAL.
SEPTEMBER, 1906.





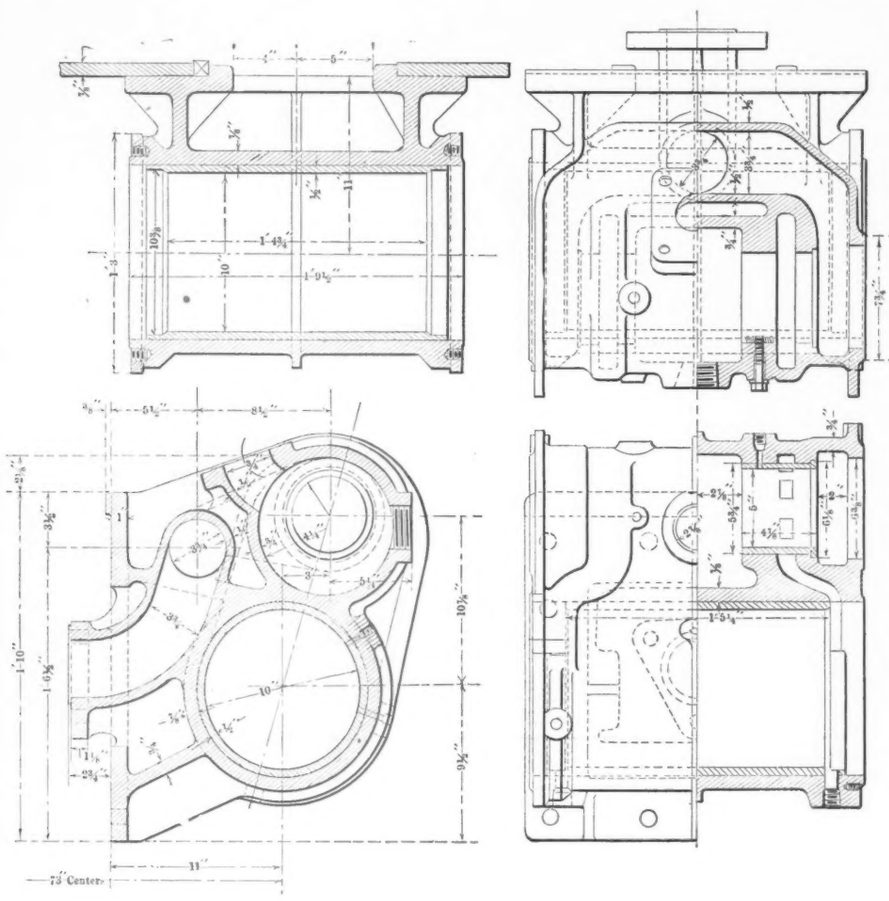
ENGINE ROOM AND DRIVING TRUCK OF STEAM MOTOR CAR—CANADIAN PACIFIC RAILWAY.

STEAM MOTOR CAR.

CANADIAN PACIFIC RAILWAY.

In the August issue, page 294, we presented a general description of the steam motor car, which was recently placed in operation on the Canadian Pacific Railway. We are fortunate in being able to present the details of the engine room arrangement, driving truck and frame, boiler and cylinders, in this issue. As shown on the floor plan, the car has an engine room, 13 ft. 7½ ins. in length; a baggage room, 7 ft. 6 ins. long; a smoking room, 12 ft. 3 ins. long, with a seating capacity for 16 persons, and a main compartment, 30 ft. 9 ins. long, with a seating capacity for 40. In order to run the car with the rear end first, a small compartment is placed at the left side of the rear end, which is equipped with an engineer's brake valve, signal valve, air valve for bell ringer, and a telegraph attachment similar to that used between the bridge and the engine room of a steamship. By means of the telegraph the motorman or engineer may be signalled as to when to stop or start, whether to go forward or backward, and the speed at which it is desired to move the car.

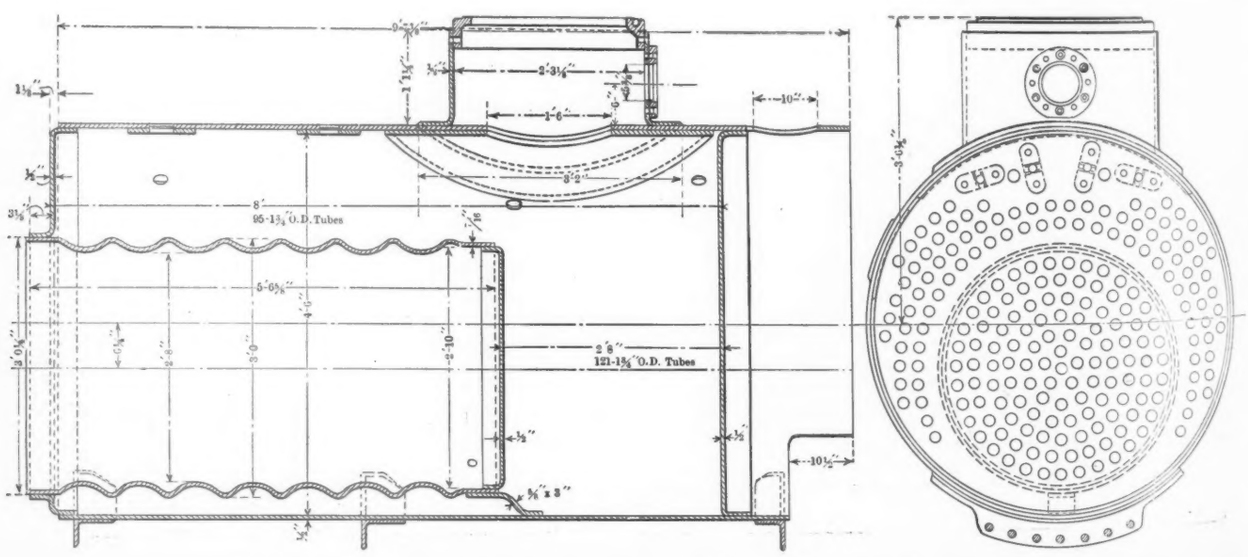
The boiler is supported directly on the frame of the driving truck, and is independent of the car body. This necessitates a rather unique construction for the truck and body bolsters. The elliptical springs, which carry the weight of the car body, rest on top of the side plates of the truck frame at either side of the body bolster. Parallel to the bolster are two steel castings, one on either side, which are supported by the springs, and from the ends of which hangers are suspended which support the cast steel truck bolsters. The body bolster is also of cast steel. The design of the center plates is somewhat different from that ordinarily used, the projection on the body bolster being much longer and of greater diameter. Susemihl side bearings are used.



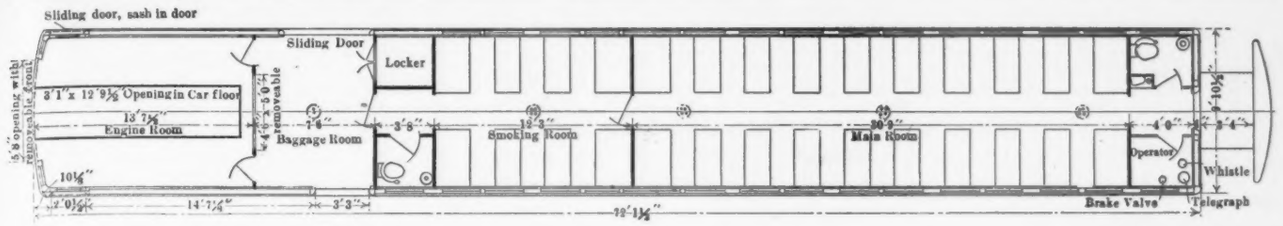
DETAILS OF CYLINDERS USED ON STEAM MOTOR CAR.

The driving truck frame is constructed of plates and rolled shapes, the arrangement of which is clearly shown on the drawing. The cylinders are bolted to an extension of the frame at the rear. A crude oil tank, with a capacity of 2,000 gals., is constructed in and forms the cross bracing of the truck frame.

The brick-lined Morrison corrugated tube furnace, 32 ins. in diameter and 5 ft. 6⅝ ins. long, is equipped with a 1-in. slot burner, of the Booth type, and with an automatic blower and oil feed device. The boiler, of the return tubular type, is equipped with 95-1¾-in. tubes, 8 ft. long, and 121-2 ft. 8 ins. long. Boiler feed water to the amount of 900 gals. is carried in 3 tanks, suspended under the



BOILER—STEAM MOTOR CAR—CANADIAN PACIFIC RAILWAY.

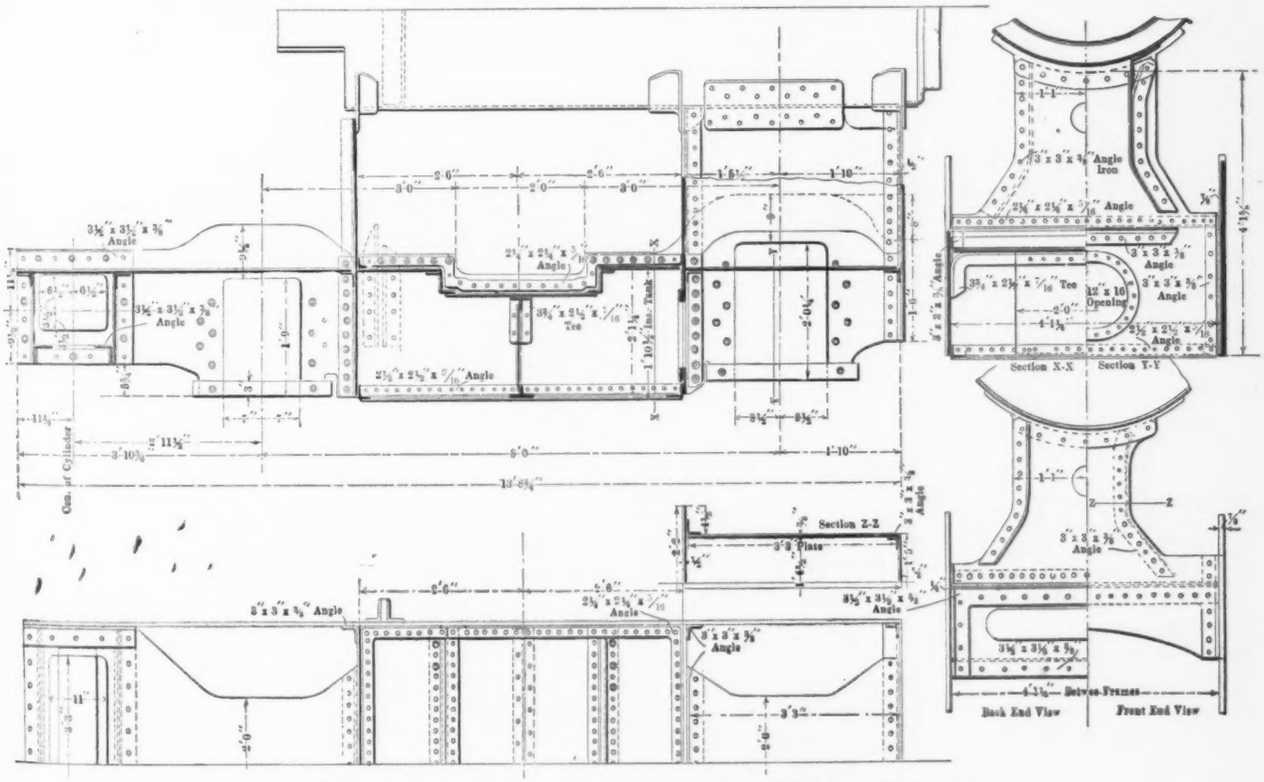


PLAN OF STEAM MOTOR CAR—CANADIAN PACIFIC RAILWAY.

body of the car. The smokebox is equipped with a superheater containing 21– 1¼-in. tubes, 9 ft. long, the arrangement of which is clearly shown on the general drawing. Steam passes from the side of the steam dome through the superheater in the smokebox and through the 2¾-in. steam pipe to the piston valve in the cylinder casting. The exhaust steam passes through a 4-in. pipe between the frames and up alongside the boiler to the smokestack at the front end of the car. A special stack or intake is placed above and encloses the safety valves to carry away the steam.

The cylinder castings are of comparatively simple design, and are bolted to the side plates of the truck frame, and in addition are keyed to the plates by taper keys 5 ins. long. The inside admission piston valve is operated by a simple design of Walschaert valve gear.

WHEELS.	
Driving, number	2
Driving, diameter	42 ins.
Trailing, diameter	34 ins.
Rear truck, diameter	36 ins.
Journals, driving	8 by 12 ins.
Journals, trailing	7 by 12 ins.
Crank pins	3 by 4 ins.
BOILER.	
Type	Horizontal, internal fire, return tubular
Working pressure	180 lbs.
Temperature, superheated steam	700-760 deg. F.
Diameter, outside	4 ft. 7 ins.
Firebox, diameter	34 ins.
Firebox, length	5 ft. 6⅝ ins.
Tubes, number and length	121-2 ft. 8 ins. 95-8 ft.
Tubes, diameter	1¾ ins.
Heating surface, tubes	485 sq. ft.
Heating surface, firebox	51 sq. ft.
Heating surface, total	536 sq. ft.
SUPERHEATER.	
Tubes, diameter	1¼ ins.
Tubes, number	21



DRIVING TRUCK FRAME—STEAM MOTOR CAR—CANADIAN PACIFIC RAILWAY.

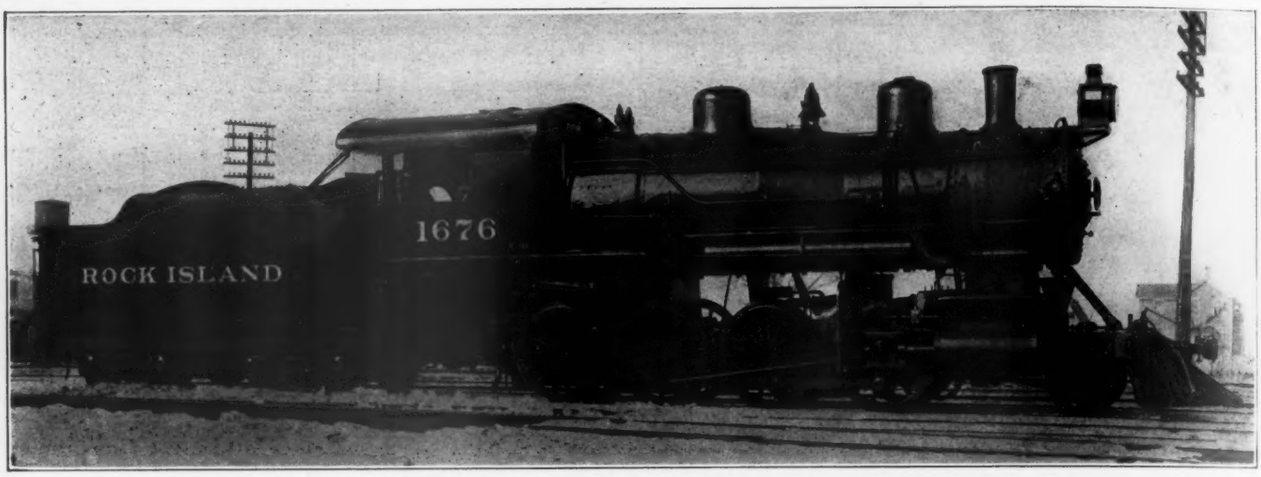
The leading dimensions and data are as follows:

Total weight	136,600 lbs.
Weight on leading truck	82,880 lbs.
Weight on drivers	42,440 lbs.
Weight on trailers	40,440 lbs.
Weight on rear truck	53,720 lbs.
Total wheel base	64 ft.
Distance between truck centers	56 ft.
Wheel base of driving truck	8 ft.
Length of car body	72 ft.
Length over all	80 ft.
CYLINDERS.	
Diameter	10 ins.
Stroke	15 ins.
VALVES.	
Style	Piston
Diameter	5 ins.
Greatest travel	3½ ins.
Steam ports	⅞ ins.
Lap, steam	⅝ ins.
Lap, exhaust	
Lead	3-16 ins.
Valve gear	Walschaert
Tubes, length	9 ft
Superheater, surface	62 sq. ft.
GENERAL.	
Fuel, crude oil under a constant air pressure of 15 lbs. per sq. in.—capacity of tank	2,000 gals.
Water storage capacity	9,000 gals.

ATTACHMENTS.

Slot burner, Booth type, 1 in.
Hancock, type A, injector with No. 5 body and No. 5 tubes.
Hancock, type A, injector with No. 5 body and No. 3 tubes.
Detroit 4—feed lubricator.
Oil tank pressure reducing valve.
Westinghouse schedule A.M.T. automatic air-brake.
Eight-inch air pump.
Telegraph attachment.
Air-brake controlling valve at rear end of car.
Acetylene lighting.
Little Giant bell ringer.
Air chime whistles.

ENGINE DEFINED.—The revised book of train rules defines "engine" as "a locomotive propelled by any form of energy."



CONSOLIDATION LOCOMOTIVE EQUIPPED WITH ALLFREE-HUBBELL CYLINDERS AND VALVES—ROCK ISLAND SYSTEM.

CONSOLIDATION LOCOMOTIVE WITH ALLFREE-HUBBELL CYLINDERS AND VALVES.

CHICAGO, ROCK ISLAND AND PACIFIC RAILWAY.

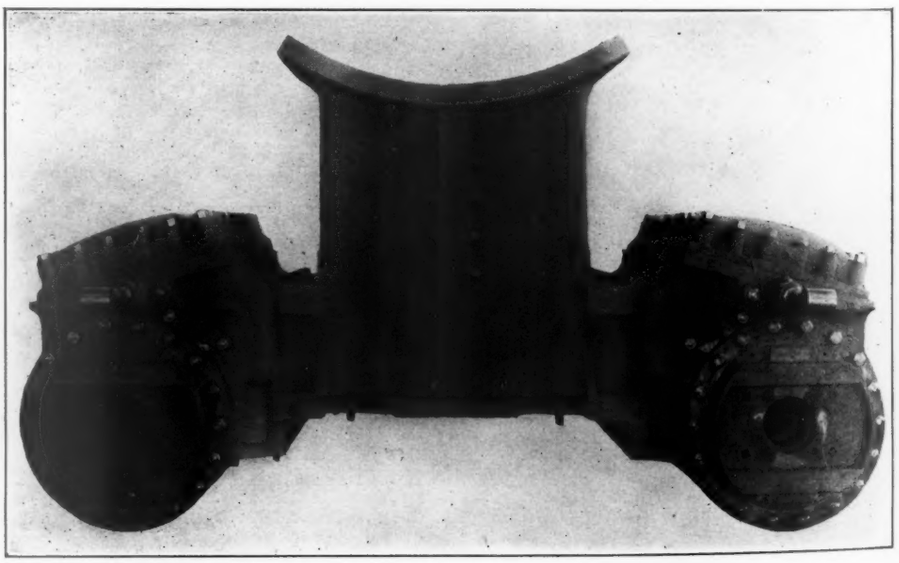
Early in 1903 the Chicago, Rock Island & Pacific Railway received from the Brooks Works of the American Locomotive Company an order of more than 100 consolidation freight locomotives. These engines were illustrated in the AMERICAN ENGINEER AND RAILROAD JOURNAL in March, 1903, page 106, and special mention was made of the excellence of the design of the valve gear and piston valves. Since being put into operation they have proved themselves to be all that was expected and have given very satisfactory service during the past three years, being operated in heavy freight service under the many varied conditions found on a large system like the Rock Island.

The motive power department of this road desiring recently to test in a practical manner the merits of the latest design of the Allfree-Hubbell valve gear equipped one of the locomotives of this class, No. 1676, with cylinders and valves furnished by the Locomotive Appliance Company of Chicago. This engine was then placed in service alongside of a regular standard engine of the same type, No. 1687, and the two engines were run single-crewed for 60 days in service west from Valley Junction, Iowa. The test began the 1st of April and ended the 1st of June, 1906. The crew which handled No. 1687 during April ran No. 1676 during May, while the crew of the latter ran the former, thus eliminating personal equation from the test. A careful record was made of the tonnage, amount of coal burned and cost of running repairs. Each engine made 26 trips, and at the end of the test it was found that No. 1676 had handled 1,479 or 5.29 per cent. more tons of freight and had consumed 32 tons or 11.07 per cent. less coal, and that the pounds of coal consumed per 100 ton miles had been 2.458 or 14.63 per cent. less, and the repairs 2.38 per cent. less on this engine.

This practical test on two locomotives which were identical in every respect except cylinders and valves, would indicate that the better distribution and more economical use of steam in the Allfree-Hubbell design had a most satisfactory result on the tonnage hauled and the cost of operation of the locomotive.

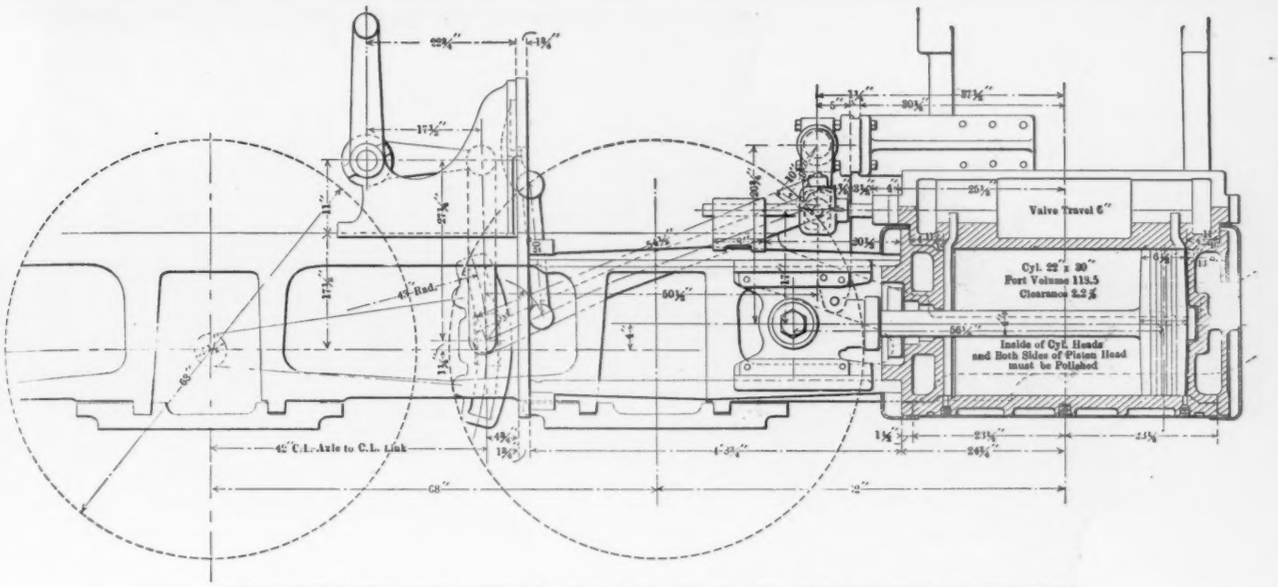
The difference in the steam distribution between the two engines lies principally in the fact that with the Allfree-Hubbell valves the point of both exhaust opening and closure is later in the stroke, and that the opening for the release of the exhaust steam is larger, allowing the cylinders to very rapidly free themselves. There are also other differences in the cylinder which undoubtedly had an effect upon the economy obtained, such as much shorter ports, the separation of the live steam and the exhaust passages in the cylinder casting, the polished surface of ports, pistons and cylinder heads and the insulation of the steam chest cover, as will be seen in the illustration of these cylinders.

The earlier designs of the Allfree-Hubbell valve gear employed the use of a geared sector operated from the cross head, which had a supplementary effect upon the movement of the valve proper by means of an eccentric connection at the rocker arm. In the latest design, however, this outside attachment has been eliminated and the valve is connected directly to the valve stem, operated by either the ordinary Stephenson or Walschaert valve gear and has no complications outside of the cylinder.

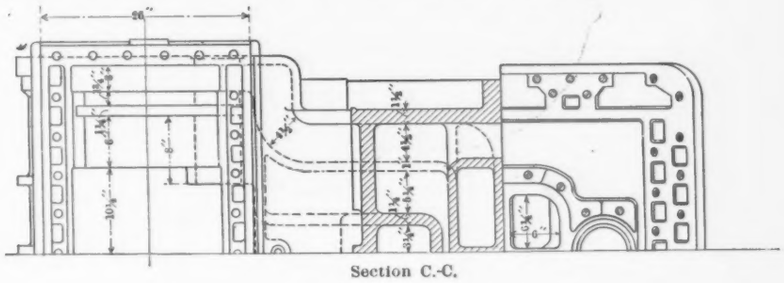


ALLFREE-HUBBELL CYLINDERS READY FOR APPLICATION TO LOCOMOTIVE.

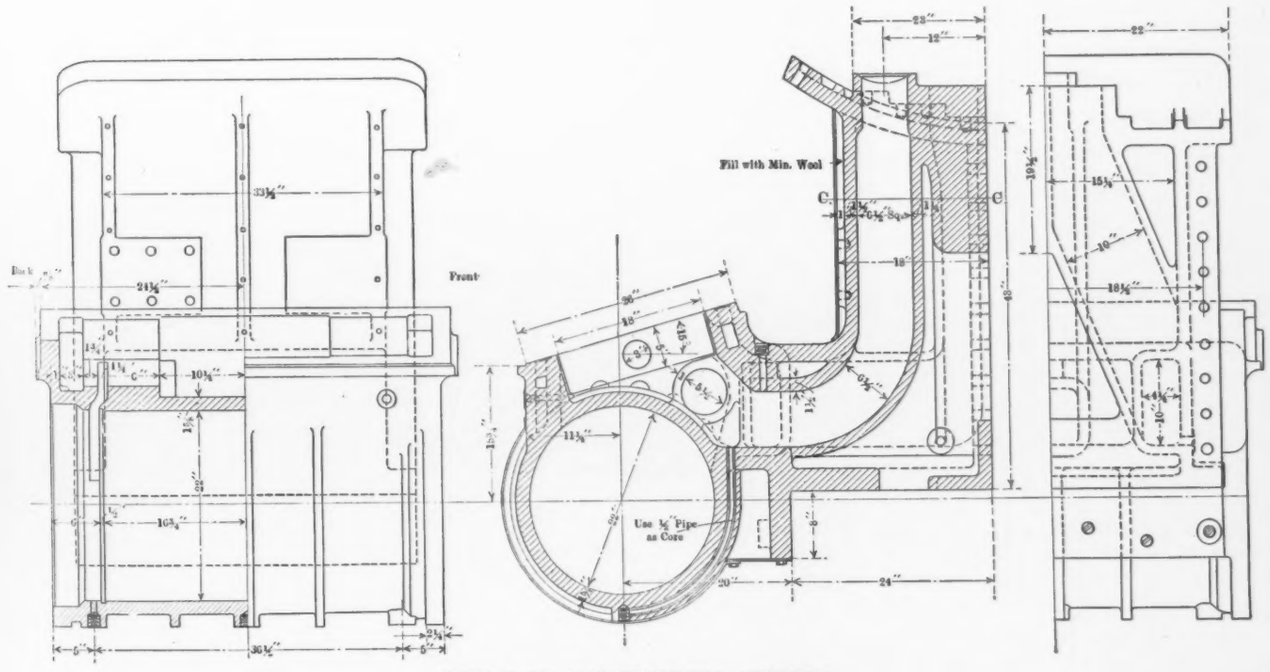
An examination of the illustrations will show the methods used for attaining the results and refinements mentioned above. It will be seen that the valve seat and valve are located at an angle of 15 deg. with the transverse horizontal, and that the space between the cylinder and the valve seat is much less than usual, which taken in conjunction with the very direct steam ports has reduced the amount of clearance,


Valve Travel 6"
Cyl. 22" x 30"
Port Volume 113.5
Clearance 2.2%
Inside of Cyl. Heads and Both Sides of Piston Head must be Polished
42" C.L. Axle to C.L. Link
4" Rod.

APPLICATION OF ALLFREE-HUBBELL CYLINDERS AND VALVES TO ROCK ISLAND LOCOMOTIVE.

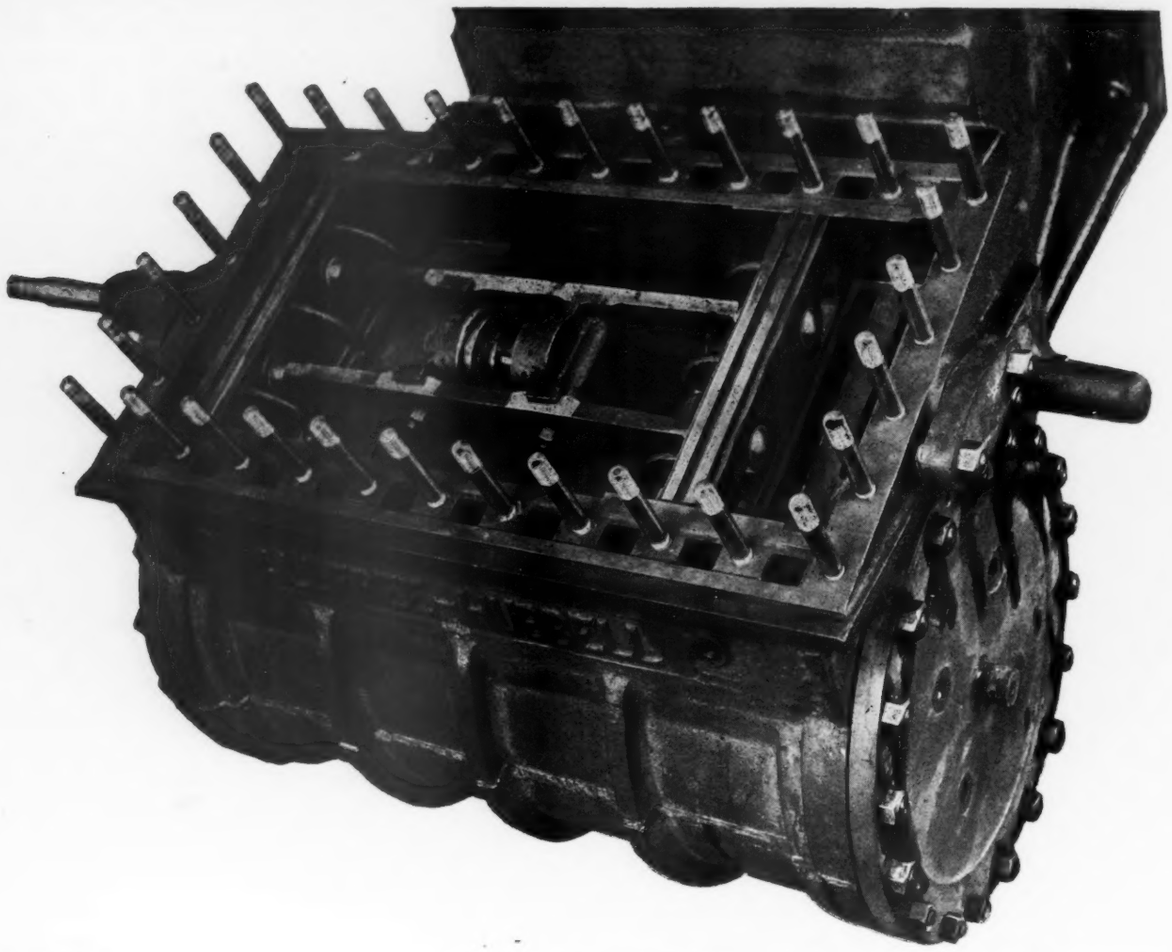


Section C.-C.

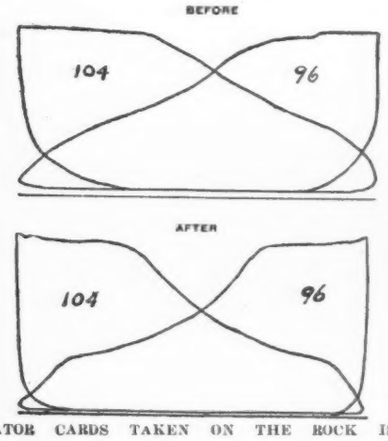


DETAILS OF ALLFREE-HUBBELL CYLINDER.

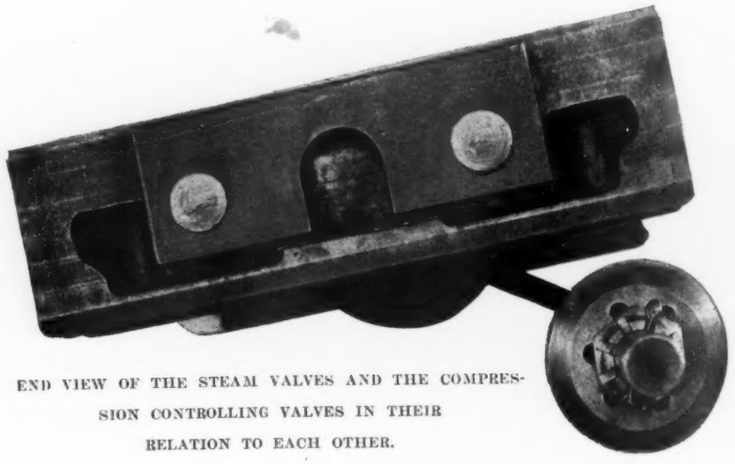
with the same clearance distance between the piston and cylinder head, from 8 per cent. to 2.4 per cent. In the wall between the cylinder port and the exhaust passage, just below the inner side of the valves, there are openings 5½ ins. in diameter which are bushed and fitted with valves. These compression controlling valves, as they are called, are simple piston valves with wide rings, and are carried in bushings pressed into place and fastened in the opening. They are guided at either end by an extension of the valve stem fitting into housings bolted on the outside of the cylinder, as is shown in the photographic view. They are operated by a dash-pot connection at the centre of the main steam valves. This dash-pot connection is so arranged as to give these supplementary valves such a movement as will make them open simultaneously with the exhaust edge of the main valve, but will retard their closing until the main valve has moved about 1¼ ins. over the exhaust port, thus giving over 23 sq. ins. exhaust opening after the exhaust closure of the main steam valve, and closing it at about 90 per cent. of the stroke in short cutoffs.



ALLFREE-HUBBELL CYLINDER SHOWING ONE STEAM CHEST COVER REMOVED, EXPOSING THE STEAM VALVE AND VERY CLEARLY SHOWING THE DASH POT CONNECTION TO THE COMPRESSION CONTROLLING VALVES WHICH LIE IN THE BACK SIDES OF THE PORTS.



INDICATOR CARDS TAKEN ON THE ROCK ISLAND LOCOMOTIVE BEFORE AND AFTER BEING EQUIPPED WITH ALLFREE-HUBBELL CYLINDERS.



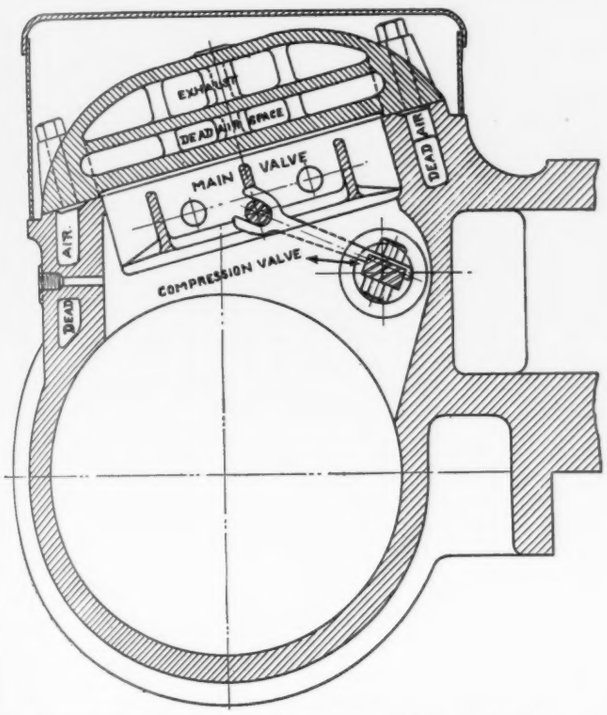
END VIEW OF THE STEAM VALVES AND THE COMPRESSION CONTROLLING VALVES IN THEIR RELATION TO EACH OTHER.

The main steam valves are of a design which is clearly shown in the illustrations and have inside admission. It will be seen that the construction gives a very light weight valve with liberal bearing area and practically perfect balance. The construction is such that even at the shortest cut-off, one portion of the bearing surface of the valve always laps the travel of another portion on the valve seat. Long experience with this type of main steam valve, which is the same as was used on the earlier design of engines, has shown them to be very efficient from a maintenance standpoint. The steam chest cover, which acts as a balance plate for the steam valve, is cored out in such a manner as to leave a dead air space between the exhaust passage and the lower or live steam surface.

An examination of the cylinder design will show that in no case is the live steam passage and the exhaust passage separated by a single wall of metal, thus preventing the loss of considerable heat in the live steam while passing through the cored passages.

As mentioned above, the sides of the pistons, the inside of the cylinder heads and the steam ports are polished. It is a well known fact that a polished surface will absorb much less heat than a rough one, but it is a refinement which has, as far as we know, never before been introduced into locomotive practice.

An examination of the indicator cards taken from locomotives equipped with this design of valve, compared with those obtained from locomotives having the regular piston or balanced slide valves, shows that by virtue of the larger actual exhaust opening, the release can be delayed very appreciably without increasing the back pressure, thus giving a longer expansion line. The delay of final exhaust closure, which is permitted by the large reduction of the clearance space, allows the back pressure line to be carried to very near the end of the stroke and adds considerably to the area of the card. These points will be made clear by reference to the two cards shown herewith, one of which was taken from engine No.



END SECTION OF ALLFREE-HUBBELL CYLINDERS THROUGH THE PORT.

1676 as fitted with piston valves and the other after the application of the Allfree-Hubbell valves. The locomotives Nos. 1676 and 1687 on which the tests were made have the following general dimensions:

SIMPLE CONSOLIDATION LOCOMOTIVE.
CHICAGO, ROCK ISLAND & PACIFIC RY.

GENERAL DATA.

Gauge	4 ft. 8½ ins.
Service	Freight
Fuel	Bituminous coal
Tractive effort	36,240 lbs.
Weight in working order	206,000 lbs.
Weight on drivers	182,300 lbs.
Weight on leading truck	23,700 lbs.
Wheel base, driving	17 ft.
Wheel base, total	26 ft.
Wheel base, engine and tender	57 ft. 6 ins.

CYLINDERS.

Kind	Simple
Diameter and stroke	22 x 30 ins.

WHEELS.

Driving, diameter over tires	63 ins.
Driving journals, main, diameter and length	10 x 12 ins.
Driving journals, others, diameter and length	9 x 12 ins.
Engine truck wheels, diameter	36 ins.
Engine truck, journals	6 x 12 ins.

BOILER.

Style	W. T.
Working pressure	185 lbs.
Outside diameter of first ring	72⅛ ins.
Firebox, length and width	67¼ x 107 ins.
Tubes, number and outside diameter	387-2 ins.
Tubes, length	15 ft. 6 ins.
Heating surface, tubes	3,087 sq. ft.
Heating surface, firebox	177 sq. ft.
Heating surface, total	3,264 sq. ft.
Grate area	50 sq. ft.

PACIFIC COAST RAILWAY CLUB.—Owing to the destruction of San Francisco and the general unsettled condition of affairs in that region, it has been decided to suspend the business of this club for the present.

COMPARATIVE COST OF REPAIRING STEEL AND WOODEN CARS ON THE HARRIMAN LINES.

Since October, 1904, there has been kept on the Harriman Lines a comparative record by months of the costs for repairing all cars of steel construction and an approximately equal number of wooden cars. The wooden cars chosen are of modern type, built about the same time as the steel cars, and therefore comparable in age, capacity and kind. The figures for the first six months of the record were given in these columns last year (July 21, 1905). Below is the statement for 17 months, which brings the record down to February of the present year. Only the totals for all lines are here given instead of for each of the constituent lines, as in the former statement.

	Steel Cars			Wooden Cars		
	Cars owned.	Total repairs.	Average cost per car.	Cars owned.	Total repairs.	Average cost
October, 1904	11,124	$19,139.45	$1.72	10,701	$35,209.02	$3.29
November, 1904	11,159	19,459.41	1.74	10,701	31,107.18	2.91
December, 1904	11,258	20,828.33	1.85	10,676	33,385.99	3.13
January, 1905	11,258	22,348.76	1.99	10,671	34,308.70	3.22
February, 1905	11,256	26,270.60	2.33	10,660	33,578.92	3.15
March, 1905	11,255	25,290.88	2.25	10,656	36,723.35	3.45
April, 1905	11,254	24,124.18	2.14	10,650	31,024.73	2.91
May, 1905	11,554	28,063.49	2.43	10,652	37,236.75	3.50
June, 1905	11,546	29,183.00	2.53	10,642	37,656.77	3.54
July, 1905	11,546	31,909.79	2.76	10,640	40,201.93	3.78
August, 1905	11,544	31,947.90	2.77	10,634	44,459.61	4.18
September, 1905	11,536	29,609.49	2.57	10,621	42,123.48	3.97
October, 1905	12,536	33,021.66	2.63	10,615	51,556.04	4.86
November, 1905	12,539	31,765.16	2.53	10,604	45,237.82	4.27
December, 1905	12,539	35,898.61	2.86	10,603	48,186.87	4.54
January, 1906	12,536	40,207.78	3.21	10,594	50,355.97	4.75
February, 1906	12,535	33,226.91	2.65	10,583	43,870.22	4.15
Av'ge per month	11,704	$28,370.32	$2.42	10,641	$39,777.84	$3.74

	Steel cars.	Wooden cars.
Box	2,900	6,232
Coal and ore	3,013	152
Flat	2,287	517
Furniture	297	276
Oil	871	248
Stock	2,305	2,699
Ballast and side dump	862	459
Total	12,535	10,583

These cars are classified as follows, based on the February total:

The average total number of steel cars involved was 11,704 against 10,641 for the wooden cars. The average monthly repair costs were $2.42 and $3.74 respectively, a difference of $1.32, or 35 per cent., in favor of the steel cars. The average total monthly difference was $11,407, or $136,884 a year. Referring to the classification, it will be observed that the wooden cars are at a disadvantage in the much greater number of box cars and the relatively small number of coal, ore and flat cars, which cost less to maintain than box cars, especially the flats. And while this causes a greater difference in the figures for average cost per car than would exist if the several classes were on an equality as regards numbers, yet considering totals this advantage is offset, in part at least, by the greater total number of steel cars involved. For February, for example, they were 1,952 in excess of the wooden cars, yet the total cost for repairs to the 12,535 steel cars for this month was $10,000 less than for the 10,583 wooden cars.

One interesting thing to note in both instances is the increase in the average cost per car per month over the period covered by the statement. For the first six months, as given in the previous statement, the respective average figures were $1.98 and $3.19. These increased in the subsequent year to $2.42 and $3.74, or by 22 and 17 per cent. respectively—the effect of an additional year of service. During this time 1,300 steel cars were bought (April-May and September-October, 1905), but no new wooden cars were added.—*The Railroad Gazette.*

RAPID CAR BUILDING.—At the Pullman shops recently an order for 1,500 cars was completed for the New York, Chicago & St. Louis Railway in twelve days, making an average of 125 cars per day.

LOCOMOTIVE REPAIR SCHEDULE.

By C. J. Morrison.

As the locomotive is the money earner of the railroad, the machine which must pay every expense and earn a dividend for the stockholders, and as it is earning only while running, it becomes all important to keep it in motion. This means not only reducing operating delays, but also reducing the time spent in the round house and the back shop. If not very carefully watched an engine is liable to spend a long time in the shop receiving repairs which could be made just as thoroughly in a much shorter time. To prevent this engines must go through the shop on a regular schedule just as a train runs on a regular schedule on the road. It will not do to assign a date when the engine is expected to get out of the shop. A specific time must be set for each operation.

All back shop repairs may be successfully handled on three schedules, namely light, heavy and general. Light repairs to consist of special jobs such as welding a broken frame, patching cylinders, etc. Heavy repairs to consist of turning tires, overhauling machinery, resetting flues, patching firebox, and such other work as may be done without placing the boiler in the boiler shop. General repairs to consist of repairs which require the boiler to be placed in the boiler shop. In one large shop where this classification is used, the number of working days allowed are 7, 14 and 25 respectively. The heavy repair summary schedule is as follows:

First Day.—Engine in shop.

Second Day.—All material delivered; engine stripped; valve bushing out.

Third Day.—Valve bushings machined; new cylinders machined; flues out.

Fourth Day.—Frame welded, or new, or straightened; valve rods, yokes and stems, throttle rigging, motion work and grate rigging forged; cylinders patched.

Fifth Day.—Valve bushings in; frames and decks, eccentrics and straps, steam chest work, cylinder bushings, valve rods, yokes and stems machined; piston rods forged; cylinders bored; guides, guide blocks and guide yokes forged.

Sixth Day.—Brake rigging, springs and rigging, and rods forged; driving boxes, tumbling shaft and boxes, steam and dry pipes, throttle valve and rigging and brake cylinder machined; new cylinders up.

Seventh Day.—Cab work and cylinder heads machined; frames and decks placed on engine and bolted up.

Eighth Day.—Rocker boxes, crossheads, brake rigging, guides and blocks, piston rods and heads machined; engine truck work and binders forged; brake cylinders and back cylinder heads up; wheels ready, machine work for link and guide and piston gangs completed; all forge work done; guides and crossheads ready.

Ninth Day.—Grate rigging and binders machined; rocker boxes, tumbling shaft, reach rod, reverse lever and guides up; flue sheets and stay bolts in; flues in; machine work for rod gang completed.

Tenth Day.—Cab and boards on engine and check valves in; throttle valve and throttle rigging up; Dry pipe in engine and boiler tested; boiler work completed; engine truck work machined; shoes and wedges laid off; miscellaneous machine work completed; steam chest work ready; drill press work done.

Eleventh Day.—Springs up; eccentrics and straps on axle; engine truck ready; steam chest work up; lagging on; shoes and wedges planed; floor work before wheeling completed; driving-box work before wheeling; motion work ready; steam pipe bench work done.

Twelfth Day.—Engine wheeled; shoes and wedges and binders on engine; piston ready; jacket on; grate rigging up; nozzle on; steam pipe in; steam pipes tested; air pump up; motion work up; cab fittings ready.

Thirteenth Day.—Cab fittings on engine completed; pistons in engine; valves set; ash pan up; front end and door on engine; rods ready; tanks ready; brake bench work done.

Fourteenth Day.—Rods on engine; pipe work completed; pilot and beam on engine; brake rigging up complete; engine out of shop; pilot braces, coupler, drawbar, etc., up; engine painted; tank painted.

Fifteenth Day.—Engine in service.

	ERECTING SHOP. LIGHT REPAIRS.	ERECTING SHOP. HEAVY REPAIRS.		ERECTING SHOP. GENERAL REPAIRS.
	Engine stripped. Material delivered. Valve bushings out.	Engine in shop, stripped, valve bushings out.	1	Engine in shop. Off wheels.
		Material delivered to the different departments.	2	Stripped. Boiler to boiler shop. Valve bushings out.
	Valve bushings in.	Valve bushings machined.	3	Material delivered to different departments.
	Cylinders patched & bored. Cylinder heads machined. Frames welded or straightened.	Cylinders patched, frames welded or straightened.	4	Frames welded or new.
	Cylinders bushed, Frames machined, Cylinder heads ground and bolted up.	Cylinders bored, frames machined. Valve bushings in. { decks machined. guide yokes forged.	5	Frames straightened.
	Frames on engine lined and bolted up. Pilot and braces on. Running-board brackets ready and up. Air pump up.	Guide yoke machined.	6	
	Cab and boards up. Boiler tested. Cylinders blown out. Steam pipes tested. Engine wheeled.	New cylinders and guide yoke up, decks and frames up, lined and bolted, Cylinder heads machined.	7	Guide yoke forged.
	Pilot and braces up. Valves set. Rods and jacket on. Out of shop. Pops set.	Wheels ready.	8	
	Engine in Service.		9	
		Running-board and cab up.	10	Frames and decks machined.
		Springs on engine.	11	
		Engine Wheeled (9 a.m.) Jacket on. Air pump up.	12	
		Valves set. Cylinders blown out. Steam pipe test.	13	Cylinder heads machined. Cylinders patched.
		Pilot and braces on. Rods up. Out of shop. Pops set (12 m.) Break in.	14	Cylinders bored.
	NOTE: NO DELAYS COUNTED UNLESS ENGINE RUNS INTO ANOTHER DAY ON ACCOUNT OF DIFFERENT DELAYS. MARK TIME GAINED AND TIME LOST, SO THAT THE AVERAGE CAN BE OBTAINED.	Engine in service.	15	Cylinders bushed. Valve bushings in.
			16	Cylinders (new) up.
	WHEN WORK IS AHEAD OF SCHEDULE MARK BY LETTER A.		17	Back cylinder heads ground and bolted up.
			18	Boiler to erecting shop. Guide yoke machined.
	SIGNS TO BE USED WHEN WORK IS HELD UP.		19	Frames and decks on engine. Lined and bolted up.
			20	Running-board brackets up. Boiler tested. Guide yoke up.
			21	Cab and running-boards up.
			22	Engine wheeled (9 a.m.) Jacket on.
			23	Valves set. Air pump up.
			24	Pilot and braces on. Rods up. Cylinders blown out. Steam pipes tested. Pistons in.
			25	Engine out of shop. Pops set. (12 m) Break engine in.
			26	Engine in service.

FIG. 1.—ERECTING FLOOR SCHEDULE FOR LIGHT, HEAVY AND GENERAL REPAIRS.

(The machine work dates are to show when the erecting shop can get the material.)

This shop is operated by the gang method and each foreman has a card showing when his particular work is to be done. The erecting floor schedule is shown in Fig. 1. These schedules are mounted on heavy cardboard with tin clips at the top and bottom of the second and fourth columns, through which clips, strips of heavy paper with spaces ruled the same as the schedule are run. The slips show the working days for each month. When an engine enters the shop its number is placed on the space for that date. Light and heavy repair engines are placed on the left-hand slip, while general repairs go on the right-hand slip. All that is necessary to ascertain when any job is to be done is to place the engine number on the movable slip against the first day of the schedule, and the date opposite the job in question is the date when it should be completed. At seven o'clock each morning a typewritten notice is handed to each foreman showing how his work stands and a summary is given to the general foreman showing how all the work stands. The general foreman is also given a report showing how many and what class of workmen each gang is short. By comparing the work report with the labor report he is able to assign men from the floating gang to gangs that are liable to fall behind. This method passes engines through the back shop with the regularity of mail train service, and combined with a system of rigid inspection and assignment of work gives the minimum delay with the minimum cost for repairs.

In order to reduce the labor charges it is necessary to know where the money is spent. It is not sufficient to know that one engine cost $1,000 and another $700. It is necessary to know that one gang's work cost $40 on one and $25 on the other, and that each of the other gangs spent so much on one and so much on the other. The superintendent of shops can then tell at once where to go to work to reduce expenses. Each gang is assigned a number. The timekeeper when taking time places this number on the card and the charges are entered up by engines and gangs. The shop is divided up as follows:

Gang.	*Name of Gang.*
1	East Machine Shop.
2	West Machine Shop.
3	East Erecting Floor.
4	West Erecting Floor.
5	Tank Truck.
6	Air Brake.
7	Valve.
9	Pipe.
10	Tool Room.
11	Steam Pipe.
12	Driving Box.
13	Drill Press.
14	Spring and Brake.
15	Grate.
16	Steam Chest Gang.
17	Brass Room.
18	Link.
20	Stripping.
21	Guide and Piston.
22	Rod.
23	Engine Truck.
24	Cab Fittings.
25	Yard Laborers.
29	Drilling Gang.
30	Boiler.
30-1	Boiler Shop—Flue.
30-2	Boiler Erecting Floor.
30-3	Ash Pan.
30-4	Steel Cab Gang.
31	Tank Boiler Work.
35	Sweepers.
40	Forge.
41	Tin Shop.
43	Wheel and Axle Shop.
47	Electricians.
52	Locomotive Carpenters.
56	Upholstering.
70	Paint.

No "Floating Gang" appears as the members of that gang are always distributed among the other gangs.

As soon as an engine leaves the shop its account is closed. In about five or six days a card, showing the cost of the work of each department, both labor and material, on the engine is placed in the hands of the superintendent of shops. He compares it with the work report, and if there is a discrepancy in any department the foreman is called to account.

A rigid inspection of each engine is made and an estimate prepared of the cost of work for each department. The portion of the work for each department is handed to the foreman of that department, as soon as the engine is stripped. A sample report for the driving box gang is as follows:

WORK TO BE DONE ON ENGINE 1,000 (HEAVY REPAIRS).

Driving Box Gang.....No. 12

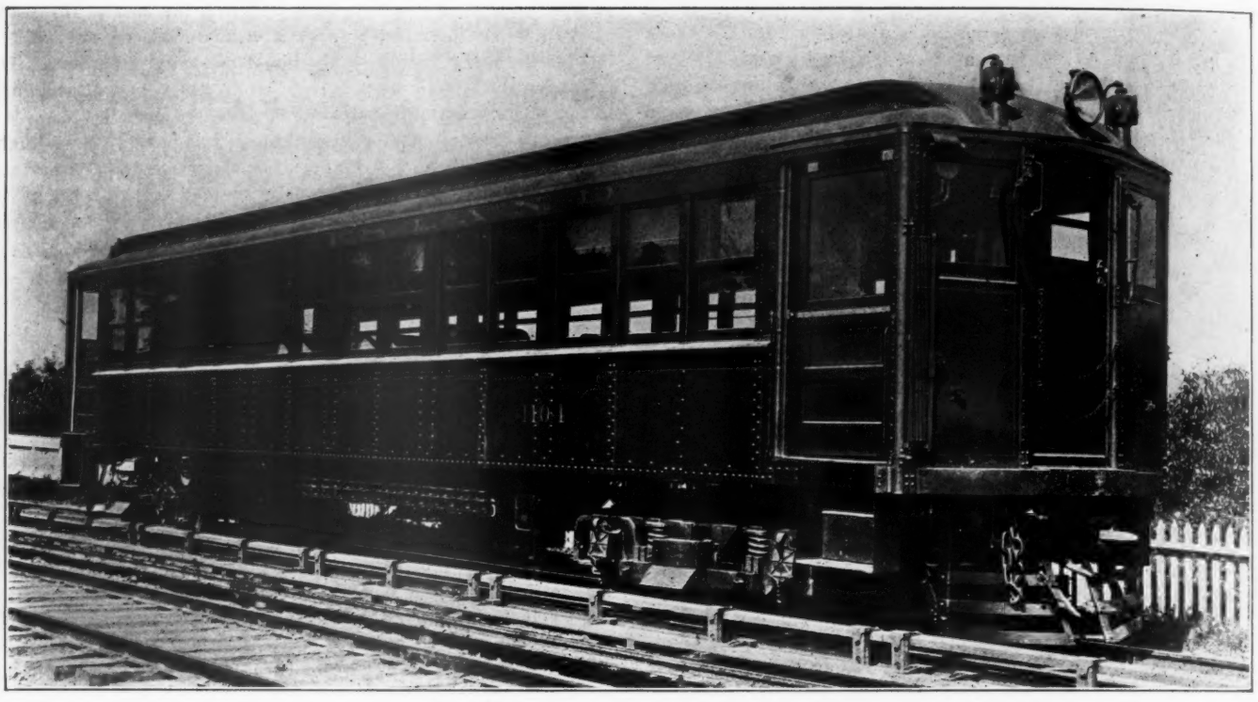
Plane the driving boxes; lay off shoes and wedges for lining and planing; rivet in liners; all brasses and lateral are in good condition; put the boxes on the journals; pack the cellars and tops of boxes; see that the spring saddles enter boxes when engine is being wheeled; put up the shoes, wedges and binders; see that the wheel centers are put to tram; engine will need new frame pedestal ties as per blue print 6/441.

He is to do no other work without permission of the inspector or the superintendent of shops. This prevents much unnecessary work and makes one man responsible for the repairs to the engine. Such foremen as are inclined to build a locomotive like a watch are restrained, while others who are liable to slight their work are spruced up. The system also prevents wasting material, as no material can be scrapped, or new material ordered without the O. K. of the inspector.

This system has not only made a considerable saving in the time for repairing engines, but has also reduced the cost of repairs an astonishing amount. At the same time the engine failures on the road have shown a steady decrease. The method, with proper modifications, can be applied to any shop.

THE COMPOUND LOCOMOTIVE.—It may seem strange, in view of the superior economy of compound locomotives, that they have not been adopted generally in place of single expansion locomotives. Compounds are apparently increasing in favor at the present time, and this is to be explained rather on the ground of the increased capacity which they render available rather than because of their superior economy. It is claimed by those who have used compounds and discarded them that the additional cost of maintenance, because of the somewhat increased complication, more than offsets the advantage gained by saving a little fuel. While this may have been true some years ago, it is not believed to apply to the more recent types of compounds, and it may even be claimed at the present time that the feature of economy may be disregarded. This is because of the very much more important attribute of the compound in applying increased capacity. At the present time railroad men are so anxious to secure the utmost possible capacity that they are willing to accept some additional trouble and expense in maintenance in order to secure the additional power which every railroad now requires in order to deal with trains of increasing weights and speeds. Reliability of service in summer and winter is now becoming very important in competitive passenger service. For this reserve capacity is necessary.

When a railroad official faces the increasing weight of trains and increasing severity of schedules he is ready to grasp at anything which will help him out of the difficulty. Because compounds do increase capacity, young men who are now preparing to enter motive power service will find it advantageous to have well defined opinions as to the possibilities of the compound to meet future requirements, which are going to be more difficult than those of the past or present. When the question of locomotive design is raised on a railroad where an additional car must be hauled and the time must be somewhat shortened, the compound locomotive lies ready at hand to meet this need. Those who are most competent to judge believe that the locomotive of the future is sure to be a compound.—*Mr. G. M. Basford, at Purdue University.*



STEEL MOTOR CAR—LONG ISLAND RAILROAD.

ELECTRIFICATION OF THE LONG ISLAND RAILROAD.

PASSENGER CAR EQUIPMENT.

The design of the car equipment of the Long Island Railroad is based upon a careful study of the traffic conditions, as they were outlined at the commencement of the undertaking, calling for trains with the number of cars varying from 2 to 6 per train at different hours of the day in regular operation and occasional trains of from 10 to 12 cars for heavy excursion travel. Some of the service is express and some local, and it was deemed of the greatest importance to provide a single type of equipment that would be uniformly available for all the varying conditions of train service.

The schedule originally planned called for speeds, including stops, of about 25 miles per hour for local trains and 30½ miles for express trains on the Atlantic Division. The service on other divisions would not exceed these speeds. A careful study of the conditions led to a decision to use the multiple-unit system for the trains, which would be composed of varying numbers of motor and trailer cars depending on the speed required. This decision, and also the fact that the Atlantic Division is partially in a subway, as well as the future need of interchangeability of equipment with the Interborough Rapid Transit Company when the tunnel from the South Ferry Station of that company underneath the East River to the Flatbush Avenue Station of the Long Island Railroad is completed, which will make posible the running of through trains from the New York subway over the Long Island Railroad, has much to do with the design of the cars.

The complete success of the all-steel passenger cars in use on the Interborough subway, which were designed by Mr. George Gibbs, led him in his capacity as chief engineer of the Long Island Railroad Electric Conversion to advocate the use of practically identical cars on this road.. These cars represent the highest development of safety for passenger traffic, as they are practically fireproof and of superior strength and durability. Thus the design of passenger car finally adopted is a practical duplication of the all-steel cars of the Interborough Rapid Transit Company. These cars were very thoroughly and completely illustrated in this journal in October, 1904, page 395, to which reference can be made for many of the details which will not be duplicated in this article.

The motor and trailer cars are practically the same with the exception of the truck, and trailer cars can readily be converted into motor cars, whenever desired, by the substitution of motor trucks.

The car bodies have the following general dimensions:

Length over draw-bars	51	ft. 4	ins.
Length over body corner posts	41	ft. ½	in.
Width over eaves	8	ft. 8	ins.
Width over sheathing	8	ft. 7	ins.
Width over window sills	9	ft. ½	in.
Height from top of rail to top of roof	21	ft. ¾	in.
Height from underside of center sills to top of roof	8	ft. 9⅛	ins.

While the conformation of the car body is practically identical with the usual type of steam railroad coaches, the adoption of steel as a constructive material is responsible for some differences in the general design of the steel frame, but most of the standard parts in the framing of wooden cars have their counterparts in the framing of steel cars, as will be seen in the following general description of the car framing.

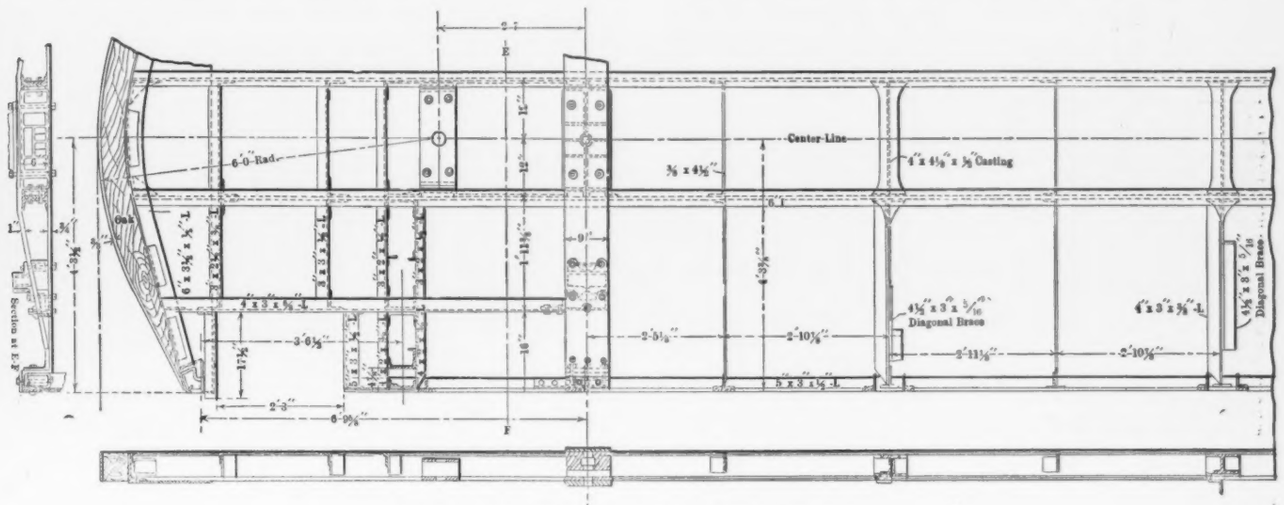
The most noticeable difference in design compared with the usual passenger coach is the method of carrying the load, which in the steel cars is all transferred to and carried by steel trusses, which form the sides of the car below the belt rail. These trusses are made up of a bulb section belt rail, the angle iron side sills, the angle, tee and channel members of the side posts and the ⅛-in. steel plate side sheathing of the car, all of which are securely riveted together and form the truss of square panels of sufficient strength to carry the full load of the car without appreciable sagging. Two 6-in. I beams, which are continuous between the platform end sills form the center sills of the car and take up the pulling and buffing stresses. These in addition to the 5 by 3 by ½-in. angles, forming the side sills, just mentioned as the bottom members of the side truss, which extend for the full length of the car body and as far as the gangway for the steps on the platform, form the only longitudinal parts of the floor outside of the 4 by 3 by ⅝-in. angles extending from the platform end sill to the bolster, making up for the discontinuance of the side sills at the step gangway.

The weight of the floor and the load is transferred to the side trusses by means of four sets of diagonal braces which reach down from the side posts of the car below the belt rail and are fastened to the floor framing, as shown in the cross section of the car. These diagonal braces are concealed in the backs of the stationary cross seats so that their presence in the car is not evident after the seats are installed. The floor framing at the point where these diagonal braces con-

nect consists of a 4x3x⅜-in. angle extending across between the center and side sills, being fastened to the T iron forming the center of the double side post at this point and by an angle connection to the web of the center sill. Between the center sills is an I section casting and passing below the sills at this point is a 3 by 3 by ⅜-in angle, which is formed with a proper shape and extends only as far as the lower end of the diagonal brace. Shorter diagonal braces located midway between the ones just mentioned and the bolster do not have the angle iron passing below the center sills, but are connected directly to the

The bolsters are of the built-up type, made up of two rolled steel plates passing above and below the center sills and machined at their outer ends to fit perfectly together. They are bent down to pass below the side sills and are fastened securely thereto in the manner shown in the illustration of the floor framing. A steel casting fits between the center sills at the body bolster. The platform is stiffened by several angle irons between the different longitudinal parts, whose location and size is shown in the floor framing.

The side posts of the car, of which there are 16 on either



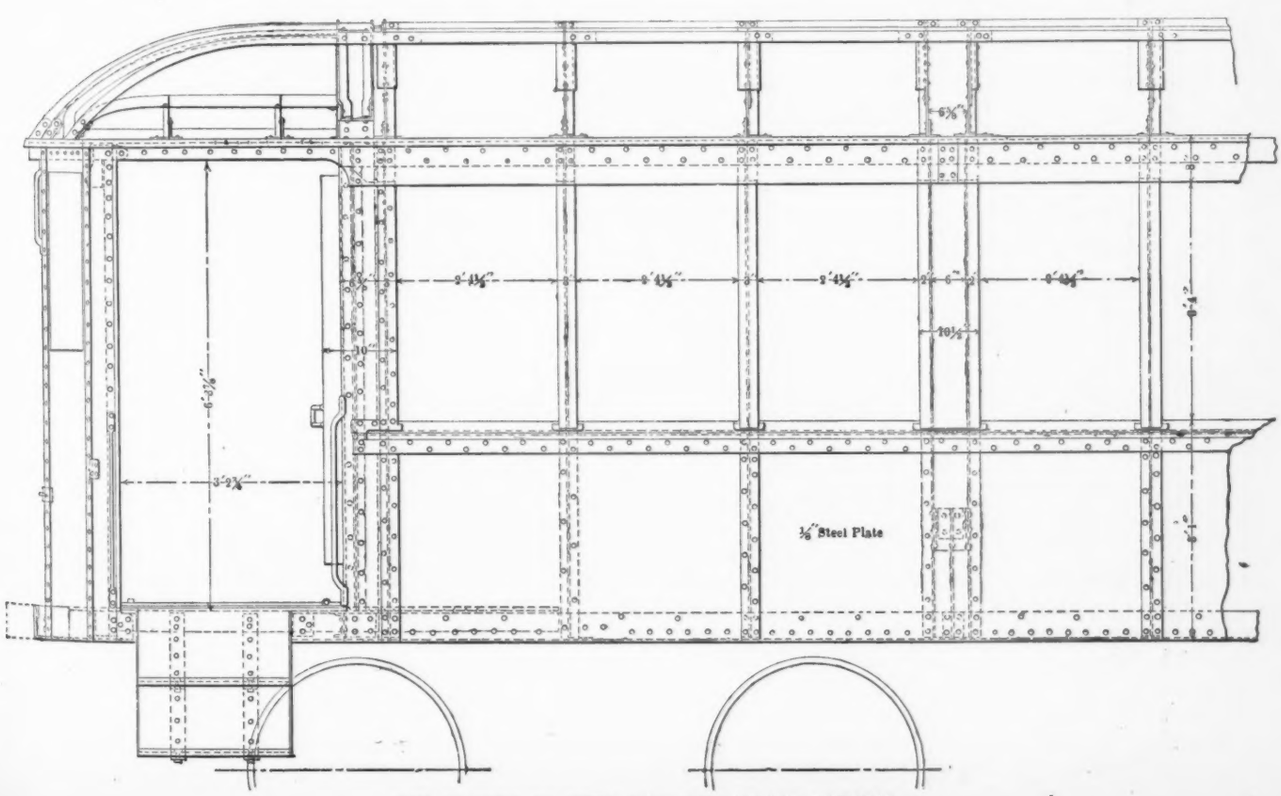
PLAN OF UNDERFRAME—LONG ISLAND STEEL CAR.

angle between the side and center sills. Between each of these diagonal braces the floor framing is further stiffened by ⅜ by 4½-in. vertical plates between sills.

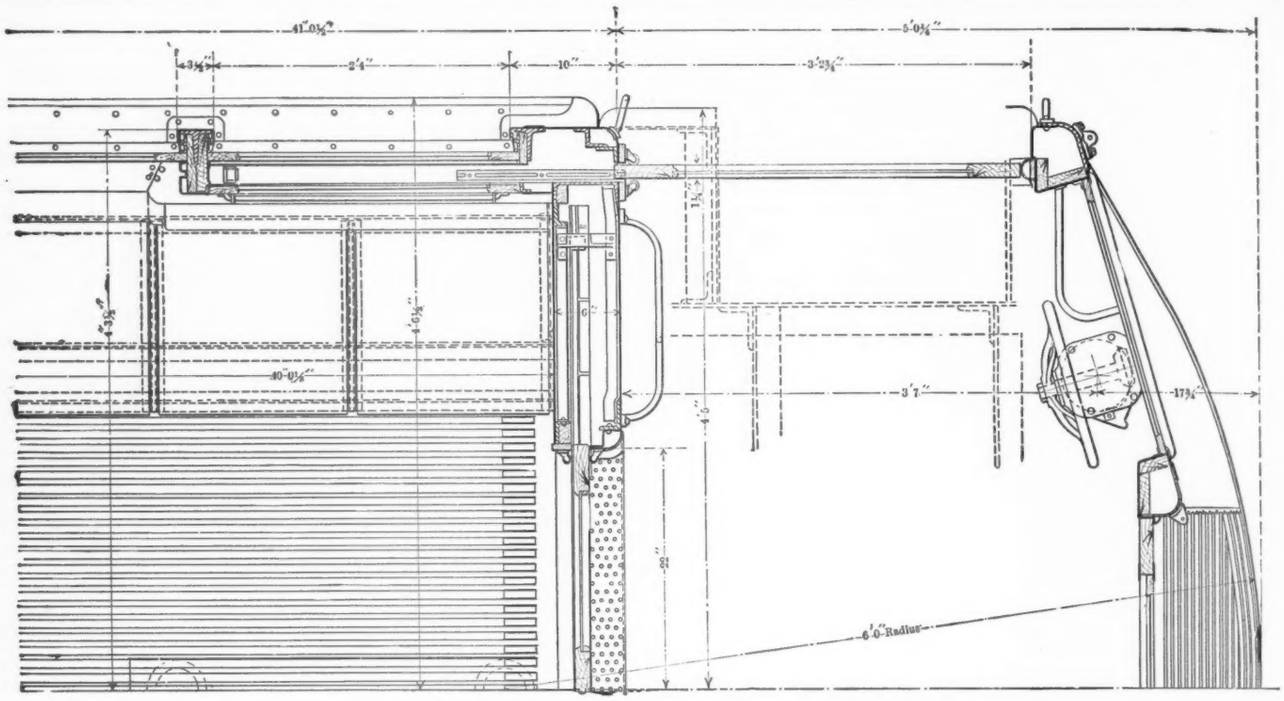
The platform sills are heavy angles bent to give the proper shape and are continuous from side to side. The vestibule end posts are fastened to them with heavy steel castings. The end sills of the car body are not made as a continuous piece extending completely across the car, but in the form of a double set of short angle bars fastened between the side and end sills by angle iron braces.

side, six being compound or double, and ten single, the former being made up of two 3 by 2 by ¼-in. angles spaced six inches apart. Between each is placed a 6 in. channel with its face turned outward and flush with the outer edge of the angle irons. In the center of this channel is fastened a 3 by 3 by ¼-in. tee, the whole being securely riveted together and forming a very stiff and substantial construction. The single side post is but 10 inches back and really forms part of the con-

which are separate from the side posts, although the first side post is but 10 inches back and really forms part of the con-



SIDE FRAMING OF STEEL CAR—LONG ISLAND RAILROAD.



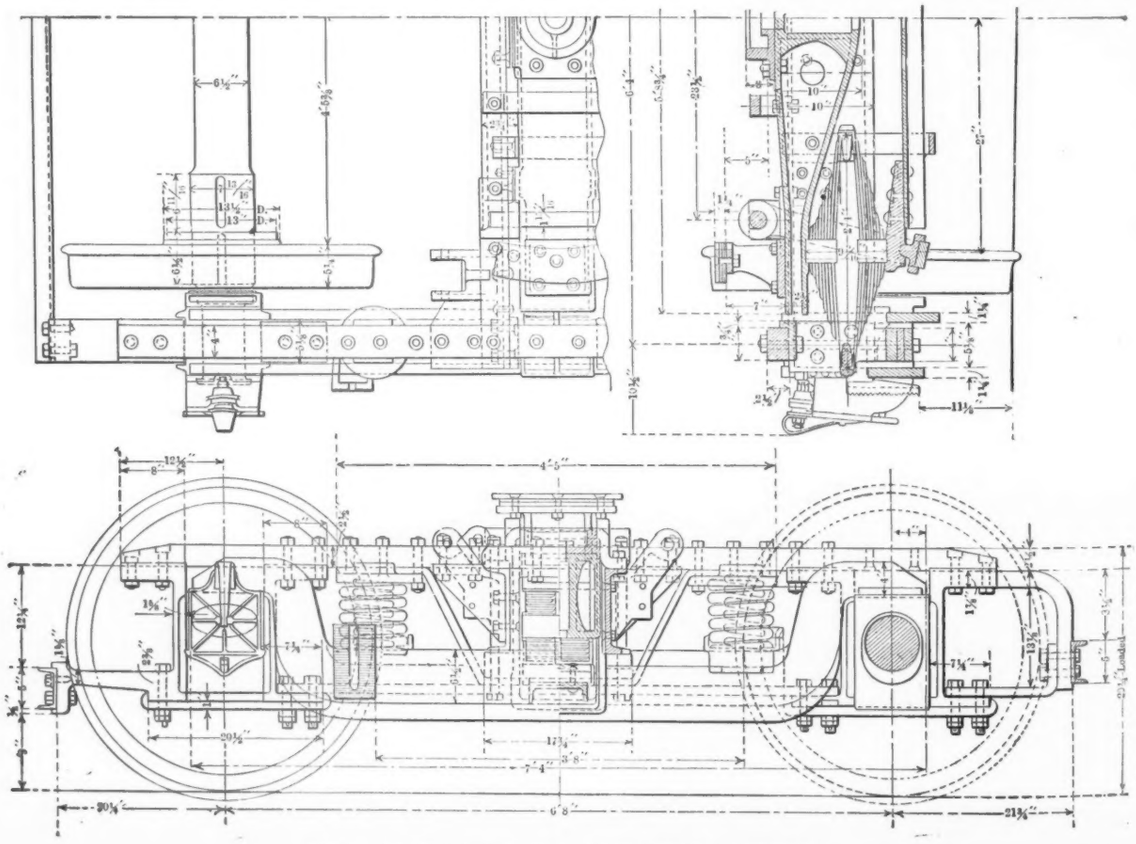
SECTION AT THE END, SHOWING ARRANGEMENT OF SLIDING DOORS.

struction of the corner posts, is built up of an angle bar fastened to the side sill and to the end plate and reinforced by a Z bar. The sheathing is rounded at the corner and riveted to this post and the first side post, forming what amounts to practically an end post 3 ins. thick by 10 ins. long. The pocket for the sliding door of the vestibule, as well as for the sliding door of the car body, requires some special construction at this point, which is shown in one of the illustrations.

The side plates, which are secured to the top of the side posts, are made up of 4½ by 3 in. angles, which are not broken at the vestibule side doors, but are continued in one piece from end to end of the car vestibule hoods.

The end plates of the car body framing are of heavy angles and are in duplicate on account of the door pocket construction. They are framed directly across at about 4 inches above the level of the side plates to which they are connected by a pair of braces of heavy angles, forming a sort of Z bar connection.

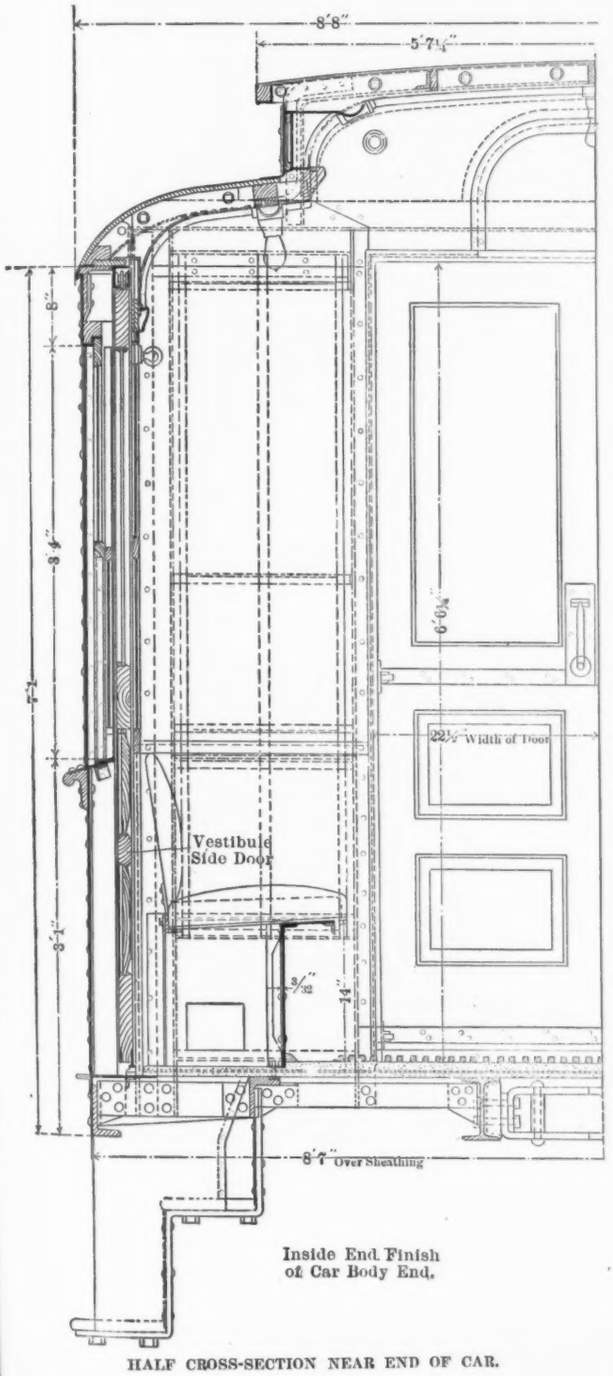
The roof framing consists of bent steel angles forming carlines connected by purlines of light steel angles. The carlines are fastened to malleable iron castings, which are riveted



MOTOR TRUCK—STEEL CAR—LONG ISLAND RAILROAD.

to the side plates. The roof of the vestibule is supported by arched angle bars which are riveted to the end bows and end carlines. A light roof covering is used consisting of composite board ⅜ of an in. thick, except over the vestibule where it is sheet steel, the whole being covered with a heavy canvas laid on with white lead.

The side sheathing consists of ⅛ in. steel plates, the lower edges being flush with the bottom of the side sill. The bulb

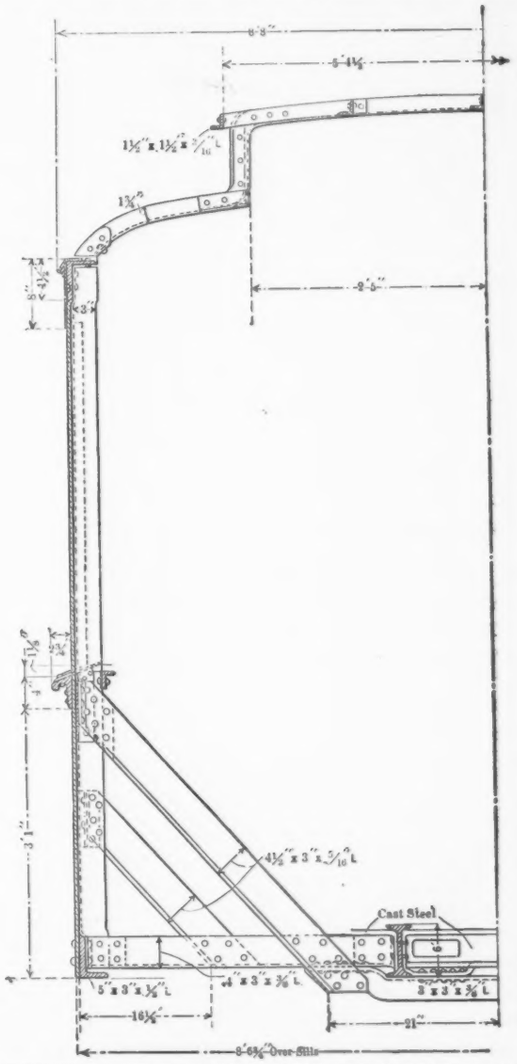


HALF CROSS-SECTION NEAR END OF CAR.

angles which form the belt rail and the window sill overlap this sheathing. The post covers between the windows are of special pressed steel flanged out at their lower ends to fit over the belt rail. The top ends of the post covers extend under the letterboard, which is a steel plate 7 1-16 ins. wide, running the entire length of the car, riveted to the side plates. All joints between the side sheathing plates are covered with steel battens laid on with thick red lead and secured by rivets.

The flooring is of corrugated iron and is supported by the longitudinal sills and the steel plate bridging riveted between the sills. These corrugated sheets are provided with metal clips which secure the "Monolith" plastic floor upon which after being finished the maple floor strips are laid and fastened with brass screws. This "monolithic" floor is absolutely fireproof and is laid in the form of cement, which when set has a smooth hard finish. The interior of the car is finished as follows: The window panels, end panels, and moulding inside of the car are of sheet steel painted a dark green striped with gold. The linings are of composite board and the hardware fittings are of lacquered bronze. The seat frames are of steel construction carried upon brackets riveted to the side posts. The cushions and seat backs are of rattan. The seating capacity of each car is 52 persons. The wainscoting is of steel backed by asbestos.

Considerable wood is used as backing and for fastening the



CROSS-SECTION SHOWING FRAMING NEAR THE MIDDLE OF THE CAR.

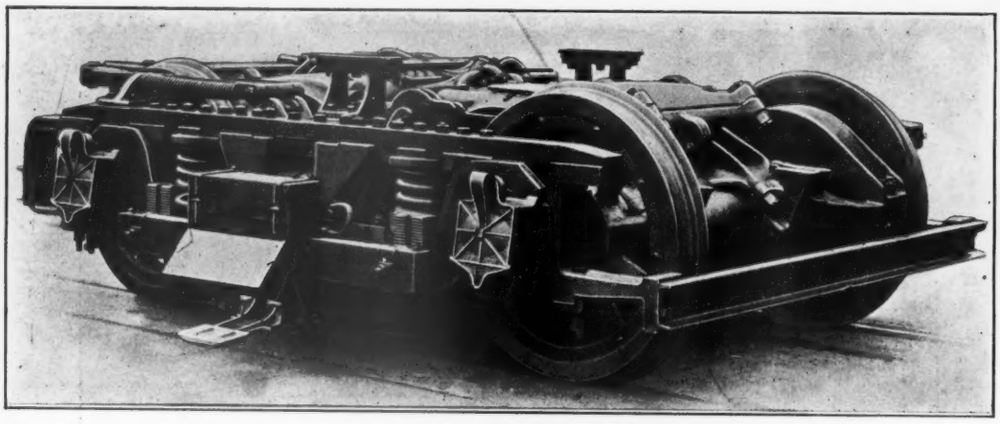
interior fittings to the steel frame work, and this in all cases is thoroughly fireproofed. It is fitted and fastened to the different steel parts by bolts and rivets in the manner shown in the different illustrations.

The draft gear comprises a spring draw bar supported by a sector bar under the car platform. The radius bar is centered upon a pin set in the cast steel auxiliary bolster bolted to the centre sills about 2 ft. 7 ins. ahead of the body bolster. Reaching back from this point to the body bolster, where it is fastened in a similar manner, is a continuation of the radius bar. On each side of the draw bar safety coupling chains are provided fitted with springs and anchor forgings.

The vestibules are the Gibbs patent type with floors of steel plate. The side doors slide into pockets in the side of the car and close against pneumatic cushions, so as to readily release the clothing of passengers if caught in the doors. The device for operating these consists of a series of bell cranks and

levers, so arranged that the movable parts are either overhead in the vestibule or entirely outside of it. The gangways leading to the side steps are fitted with drop doors of 3-16 in. steel plates. The vestibule floor and drop doors are covered with the Mason patent floor covering. The vestibule end door when in the extreme open position is folded over the master controller, brake valve and other apparatus in the motorman's compartment. When it is closed the entire vestibule is available for the motorman.

All motor cars are equipped with pilots suspended from the platform buffers, and an air whistle is provided over each vestibule.

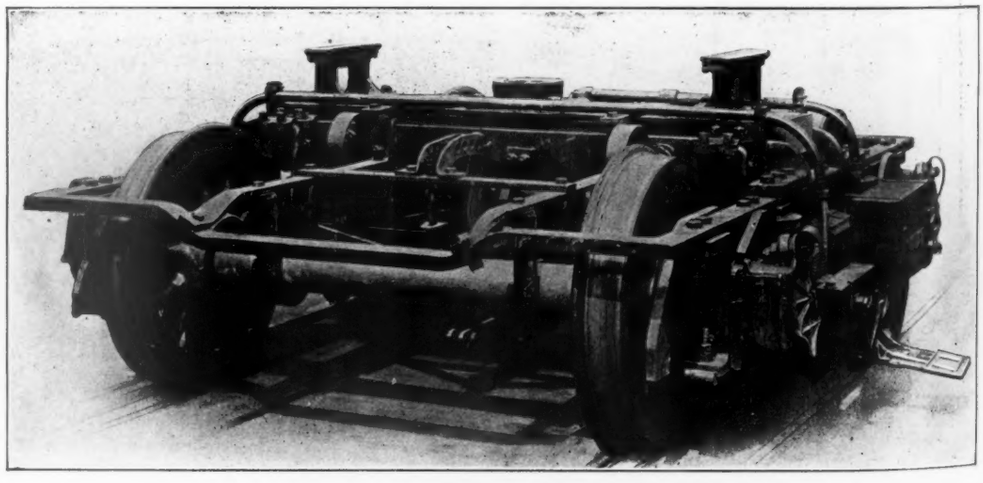


MOTOR TRUCK—LONG ISLAND STEEL CAR.

Trucks.

The motor and trailer trucks, there being one of each under each motor car, are of the M. C. B. type, the wheel base of the motor trucks being 6 ft. 8 ins. for 36-in. wheels, and of the trailer trucks 5 ft. 6 ins. for 30-in. wheels. The distance between truck centers is 34 ft. The motor truck bolsters and center plates are steel castings machined where necessary. The side frames are of rolled iron machined on all sides. The end frames are steel channels. The pedestals are forgings lipped over the side of the side frames and machined where they have a bearing. The transom consists of a rolled steel channel resting in a casting, forming part of the side frame and provided with chafing plates of wrought iron. The pedestal caps are of wrought iron machined and carefully fitted to the pedestals. The wheels are steel tired with cast steel spoke centres The journal boxes are of cast steel and were furnished by the T. H. Symington Company of Baltimore.

The trailer trucks differ from the motor trucks largely in the matter of size, having, however, a built up bolster of wood and iron plates. Both the motor and trailer trucks were manufactured by the Baldwin Locomotive Works, Philadelphia, Pa.



TRAILER TRUCK—LONG ISLAND STEEL CAR.

The cars are equipped with hand brakes and with the Westinghouse quick service automatic air brake. This brake is of a new design developed from the quick action brake. Air is furnished by electrically driven compressors on each motor car, which have a capacity of 24 cu. ft. of free air per minute. This type of brake has a number of advantages over the standard apparatus, in that it has a quicker serial service application, a more graduated release of cylinder pressure, quicker charging of auxiliary reservoirs and better protection against over pressure. The modifications made in the quick action brake to obtain these advantages, allow the brake to be applied more rapidly and materially reduce the distance required to stop the train. The advantage of the quick charging of the auxiliary reservoir is particularly valuable in the rapid transit service where frequent stops are necessary. All motor and trailer cars are provided with automatic slack adjusters.

Electrical Equipment.

The selection of the electrical equipment of the motor cars, whether operated singly or in trains, required a most careful study of the loads to be handled, the schedule conditions and the limitations of the apparatus itself. A careful investigation showed that the greatest flexibility would result from a two motor car equipment, using the most powerful motors practicable. The limitation in the size of the motors was mainly that of the space allowable in the truck, and this restricted the size of the motor to about 200 h.p. Two motors of this size, which are known as No. 113 Westinghouse type, are mounted on the motor trucks and drive the axles through gearing, the pinion on the armature shaft having 25 teeth and the gear on the axle 56 teeth. The motors are supported by a bearing on the axle and by a spring nose suspension from the truck frame.

The Westinghouse electro-pneumatic multiple control system, which was adopted, uses air pressure for operating the switches which control the motor speeds and connections, which air pressure is controlled by valves operated by electric magnets. These magnetic valves are electrically operated from the master controller. The current for operating the air valves is obtained from an independent storage battery of seven cells carried on each motor car. This storage battery is automatically charged from the same circuit that operates the air pump. The air pressure is obtained from the auxiliary reservoirs.

Special precaution was taken to place automatic safe guards at every possible point in the electrical equipment. It is so arranged that too much current or none at all will automatically bring the control apparatus to the off position, and a very slight movement of the master controller handle from this position back to the centre of the notch applies the brake instantly.

The cars are heated throughout with electric heaters of the

INTERIOR OF INSPECTION SHED AT DUNTON—LONG ISLAND RAILROAD.

panel type placed underneath the seats, and were supplied by the Consolidated Car Heating Company for the motor cars, and by the Gold Car Heating & Lighting Company for the wooden trailers.

The following table gives the weights of the principal elements of the steel motor and its equipment:

	Pounds.
Body	31,377
Draw-bars	988
Foundation air brakes	1,165.5
Brake pipes and fittings	520
Brake schedule parts (including compressor)	2,383.5
Door operating device	340
Supports for electrical apparatus	438
Curtains	99
Seats	844
Motor truck, with gears and third rail shoes	14,129
Two Westinghouse No. 113 motors	14,430
Trailer truck with third rail shoes	9,719
Electrical apparatus and conduit	4,857
Lights, heaters, flexible conduit and wire mouldings	848
	82,138
Maximum passenger load, estimated	16,000
Total	98,138

In addition to the passenger car equipment five electric express cars have been provided, which are equipped with the standard type of motor and trailer trucks and the standard multiple control apparatus. These cars are built of wood, 52 ft. 5 ins. over all. They are equipped with standard M. C. B. couplers, and haul the old standard baggage and express cars as trailers. A rotary snow plow has also been provided, built by the Peckham Manufacturing Company, equipped with one motor and one trailer truck of the standard type, as well as all of the standard motor car electrical equipment. A set of revolving blades with fan and housing is mounted at each end of the car and is operated by a line shaft running through the car and fitted with two friction clutches, one for each end section; the centre section carries two 50 h.p. railway type motors run by a series parallel controller.

Car Shops.

The facilities provided for inspection and repair of electric motor cars consists partially of a section of the original car shop at Morris Park, which has to a certain extent been remodeled to better accommodate the new motive power, and also of two inspection pits, one at Rockaway Park and the other at Dunton. The interior of the latter is shown in the illustration.

At Morris Park a new shop was built paralleling the old car shop with a transfer table situated between them. There are 13 pit tracks, each of which will accommodate two motor cars with plenty of space between them. Two tracks in this shop are provided with traveling cranes for handling motors and axles, and to facilitate general truck repairs. The original machine shop was equipped with new tools for turning wheels and axles, and for pressing wheels and gears upon the axles.

The inspection sheds occupy the place held by a roundhouse in steam locomotive operation, and the one at Rockaway Park is of steel framing and brick walls. It has two tracks running completely through it, with doors at each end. Each track is provided with concrete lined pits through the entire length. An addition, which includes the machine shop, storehouse and office, is situated at one corner of the building.

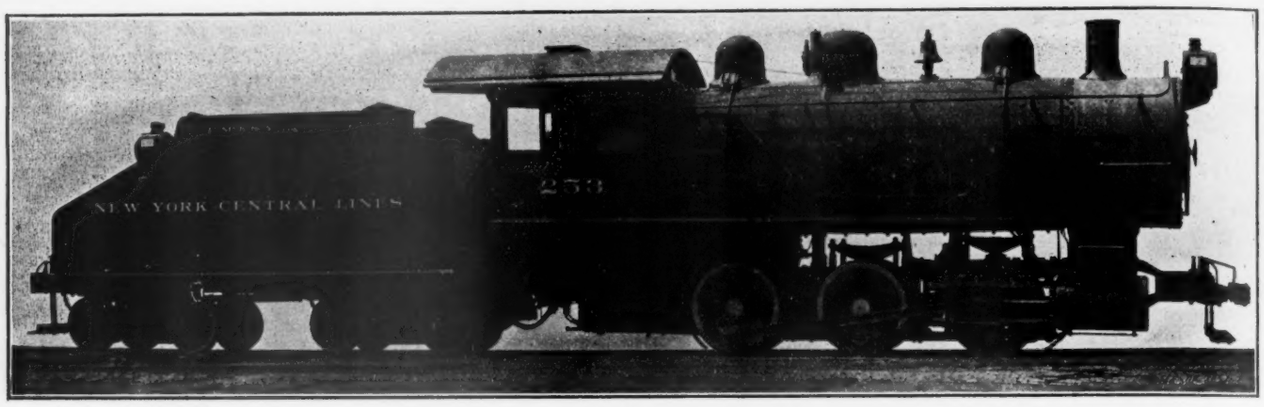
The larger inspection shed is located at Dunton and is constructed entirely of reinforced concrete with roof trusses of steel plate girders, supported in the centre of the building on latticed columns. The building consists of one central and two side sections, the entire section extending above the others and forming a broad clear story with side windows. The building is 242 ft. 8 ins. in length and 94 ft. wide. The roof is composed of reinforced concrete covered with pitch, felt and gravel roofing. Six tracks run completely through the building, the doorways at either end being fitted with rolling steel doors. The tracks are all provided with pits three feet in depth below the base of the rail. The Rockaway Park shed will accommodate 12 cars and the Dunton shed 24 cars.

The contract for 134 steel car bodies was let to the American Car and Foundry Company on January 20, 1905, and the first car body was received ready for equipment early in April, 1905, and by August the entire number of steel cars had been delivered at the shops.

The entire work of design and construction was in charge of Mr. Geo. Gibbs, chief engineer of electric traction of the Long Island Railroad.

To Make Vandyke Prints More Transparent.—To a pint of best gasoline, add as much paraffine as the gasoline will readily dissolve and spread this solution evenly over the print with a soft brush, wipe dry with a piece of white cotton rag and print in the usual manner. Vandyke prints treated in this way will require only about two-thirds the usual time to print.— *Mr. E. W. Bowen in Machinery.*

Steel Passenger Car in a Wreck.—One of the steel mail cars on the Erie Railroad was recently derailed near Burbank, Ohio, and plunged down a 12-foot embankment, turning over three times. The car was only slightly damaged and the two mail clerks escaped with slight bruises. Baggage and express cars immediately behind the steel car were badly wrecked. The favorable showing made by the steel car should encourage the use of steel in passenger car construction.



HEAVIEST 0—6—0 TYPE SWITCHING LOCOMOTIVE—PITTSBURGH & LAKE ERIE RAILROAD.

HEAVY SIX-WHEEL SWITCHING LOCOMOTIVE.

PITTSBURGH & LAKE ERIE RAILROAD.

The Pittsburgh & Lake Erie Railroad recently had a number of very heavy six-wheel switching locomotives built at the Pittsburgh works of the American Locomotive Company. These engines were designed to push heavy trains up the "hump" in the gravity yards. As the total weight is equal to the weight on drivers of the most powerful consolidation locomotive in use on this road, and as the tractive effort of 44,100 lbs. is also equal to that of the consolidation locomotive, it is possible for them to handle any train which is hauled into the yards.

The total weight is 176,500 lbs. and the average load per wheel is 29,416 lbs. This, we believe, is the heaviest locomotive of this type ever built in this country, or in the world, and the load per wheel is greater than that of any other locomotive in our records. The heaviest engine of this type, previously built, was the Class B6 constructed by the Pennsylvania Railroad in their Altoona shops in 1904, and described on page 384 of the AMERICAN ENGINEER for that year. These weighed 170,000 lbs., with an average weight of 28,333 lbs. per wheel. These two engines are in a class by themselves among six-wheel switchers, exceeding all others by from 15,000 to 20,000 lbs. in weight.

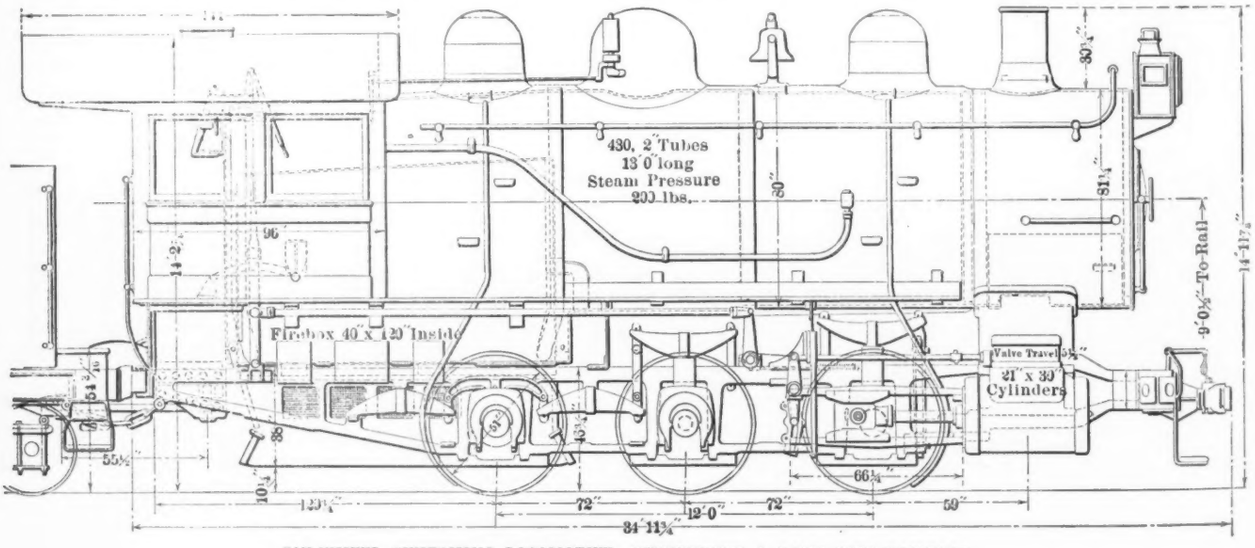
The reason for placing this excessive weight on three pairs of wheels rather than distributing it over more drivers in an 0-8-0 or 0-10-0 type was to keep the rigid wheel base as short as possible, the wheel base being 12 ft. The P. & L. E. officials believe that a switcher with this wheel-base will work better over frogs and switches, and with greater safety from derailment than one with a larger wheel base. Mr. L. H. Turner, superintendent of motive power, advises that these engines are used in three different yards, and that their performance has been entirely satisfactory. They have been in service over two months.

Just what effect the excessive weight will have on the rate of wear of the rail is a question. Even though the rate of wear should rapidly increase it will probably prove a small item as compared to the fact that these engines will do the work of two six-wheel switchers of ordinary size, thus greatly facilitating the work in the classification yards and simplifying the problem of taking care of the constantly growing traffic.

To keep the bearing pressure within reasonable limits, the journals are unusually large, 10½ by 13 ins. The ratio of the heating surface to the cylinder volume is somewhat higher than the average. Following are the leading dimensions and data:

SIX WHEEL SWITCHING LOCOMOTIVE.
PITTSBURG & LAKE ERIE R. R.

GENERAL DATA.	
Gauge	4 ft. 8½ ins.
Service	Switching
Fuel	Bituminous coal
Tractive power	44,100 lbs.
Weight in working order	176,500 lbs.
Weight on drivers	176,500 lbs.
Weight of engine and tender in working order	305,500 lbs.
Wheel base, driving	12 ft.
Wheel base, total	12 ft.
Wheel base, engine and tender	46 ft. 2¼ ins.
RATIOS.	
Weight on drivers ÷ tractive effort	4
Total weight ÷ tractive effort	4
Tractive effort x diam. drivers ÷ heating surface	722
Total heating surface ÷ grate area	93.5
Firebox heating surface ÷ total heating surface	6.6
Weight on drivers ÷ total heating surface	56.8
Volume both cylinders	12 cu. ft.
Total heating surface ÷ vol. cylinders	259
Grate area ÷ vol. cylinders	2.78
CYLINDERS.	
Kind	Simple



SIX-WHEEL SWITCHING LOCOMOTIVE—PITTSBURGH & LAKE ERIE RAILROAD.

Diameter and stroke	21 x 30 ins.
VALVES.	
Kind	Balanced slide
Greatest travel	5½ ins.
Outside lap	⅞ in.
Inside clearance	0 in.
Lead in full gear	1-16 in.
WHEELS.	
Driving, diameter over tires	51 ins.
Driving, thickness of tires	3½ ins.
Driving journals, diameter and length	10½ x 13 ins.
BOILER.	
Style	Straight
Working pressure	200 lbs.
Outside diameter of first ring	80 ins.
Firebox, length and width	120 x 40 ins.
Firebox, water space	4, 4½ ins.
Tubes, number and outside diameter	430, 2 ins.
Tubes, length	13 ft.
Heating surface, tubes	2,906 sq. ft.
Heating surface, firebox	206 sq. ft.
Heating surface, total	3,112 sq. ft.
Grate area	33.3 sq. ft.
Smokestack, diameter	17½ ins.
Smokestack, height above rail	15 ft.
TENDER.	
Tank	U
Frame	Steel channel
Wheels, diameter	33 ins.
Journals, diameter and length	5½ x 10 ins.
Water capacity	7,000 gals.
Coal capacity	10 tons

RELATIVE MOVEMENT OF FIREBOX AND OUTER SHEETS.

In its report before the Master Mechanics' Association the committee on flexible staybolts cited a number of tests, which had been made to determine the relative movement of the firebox and boiler sheets, in their own plane, while heating the cold water to the working pressure temperature (AMERICAN ENGINEER, page 321, August issue). The greatest movement was obtained in a radial stay crown sheet where the difference in the movement of the two sheets amounted to almost 3-32 inch.

In discussing the report Mr. Max H. Wickhorst called attention to the fact that the relative movement of the two sheets would probably have been considerably greater, if they had been covered with scale instead of being clean. He said: "It strikes me that probably the main reason of the large movements of such sheets is the forming of scale, mud or

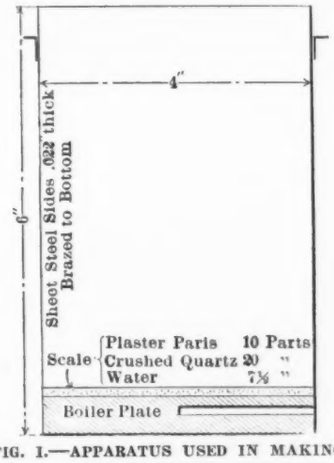


FIG. 1.—APPARATUS USED IN MAKING TEMPERATURE TESTS.

other insulating material on the firebox sheets. I made some temperature tests which indicated that with a hot firebox, a ½-in. sheet cannot be raised above the temperature of the water more than 40 or 50 deg. F., but allow ⅛ in. of scale to form and the temperature of the metal will rise above the temperature of the water by several hundred degrees. In fact, with a hot fire and ⅛ in. of scale on the staybolts and sheets, the sheets can actually attain a low red heat. As the relative movement of the sheets is probably primarily, a function of the difference in temperature more than any one thing, it will be seen that if the temperature of the inside sheet is allowed to be materially increased, the movement is going to be greater, and I rather imagine that if the test had been made with scaled sheets, that a greater movement would have been found. For instance, by opening the fire door, after a good hot fire, with a temperature of the water say, 400 deg. or a little lower, the temperature of the firebox sheets would easily be raised to 600, 800 or 1,000 deg.; whereas, if the sheets are perfectly clean, their temperature probably would not have been raised to over 450 deg."

The following description of the experiments made by Mr. Wickhorst and referred to above was given in a paper on "Firebox Steel—Failures and Specifications," presented by him at the recent meeting of the American Society for Testing Materials:

"In order to get some information concerning the temperatures actually attained by locomotive firebox sheets, etc., under conditions of service, I arranged to get an electric pyrometer consisting of a platinum thermo-couple and galvanometer, and the intention was to work the boiler at rates similar to service conditions, and insert the junction of the thermo-couple through a small hole drilled in a stay bolt, extending across to near the fire side. Tests of this kind have not as yet been made, but some preliminary results have been made with the apparatus shown herewith as Fig. 1. From this it will be seen that the method of test consists of boiling water in a can with thin sheet steel sides, with a bottom of half inch boiler plate, 4 ins. in diameter brazed to the sides. The boiler plate has a hole drilled into the side ⅛ in. in diameter extending to

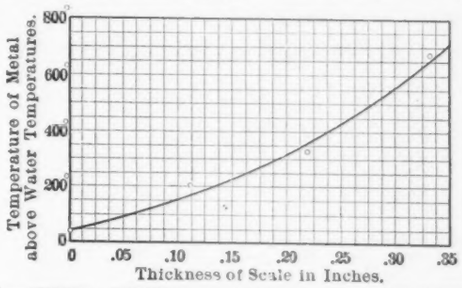
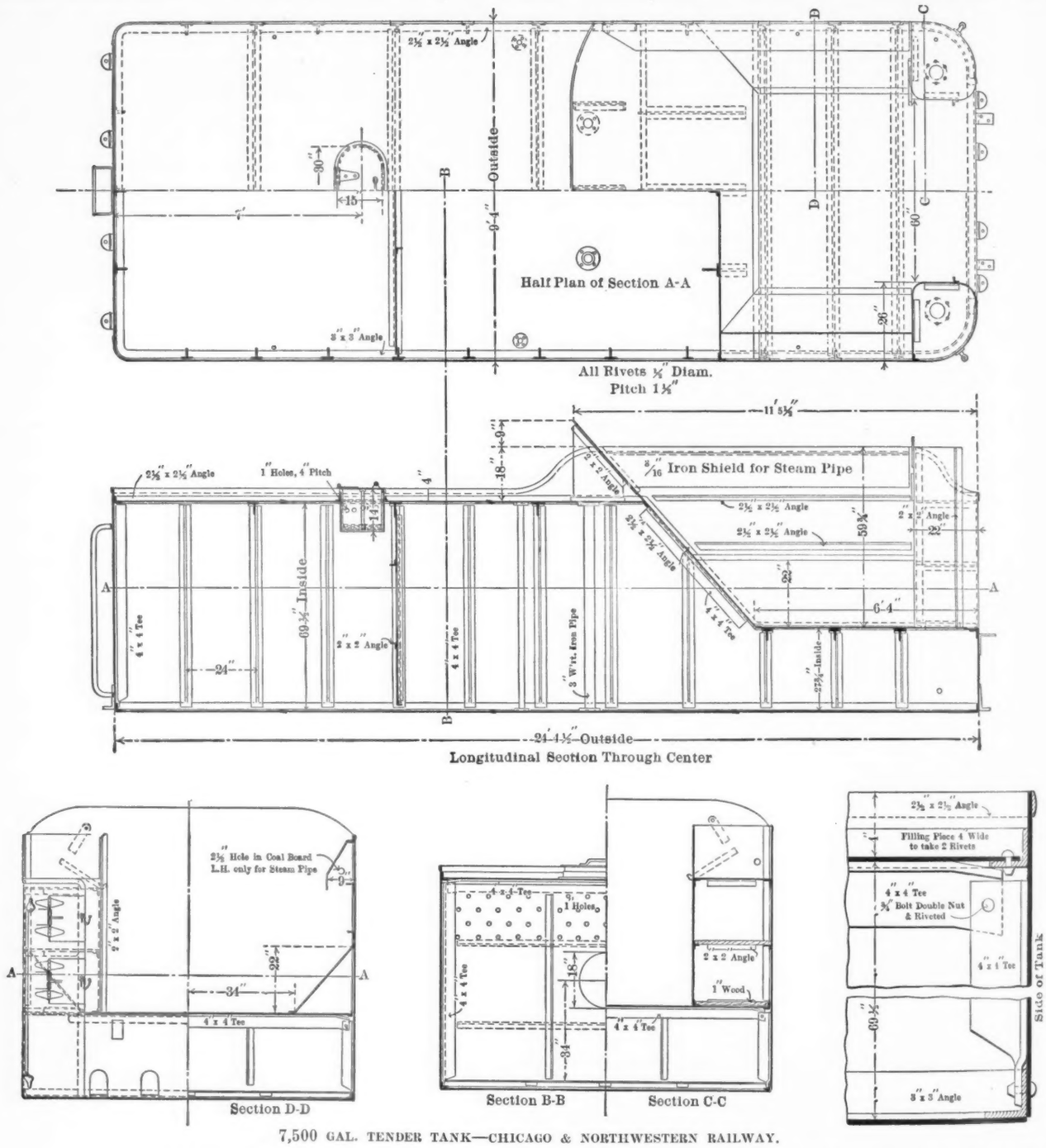


FIG. 2.—CURVES SHOWING VARIATION OF TEMPERATURE OF FIREBOX STEEL CAUSED BY VARIOUS THICKNESSES OF SCALE.

the middle of the plate. Heat is supplied by a specially constructed "pepper box" burner which gives a lot of gas flames over a flat circular area of about 4 ins. in diameter. The junction of the thermo-couple is inserted into the hole of the plate to the middle, and the temperature is read on a galvanometer. Some preliminary results are shown in Fig. 2, from which it will be noted that if a firebox sheet (including flue sheet) or the flues are free from scale or mud, the temperature of the metal probably does not at any time exceed the temperature of the water more than 50 deg. F., providing of course the circulation is sufficient to keep the water always in contact with the metal. Under the conditions of this experiment with no scale or water on the plate, the metal attained a temperature of about 1,300 deg. F., and it will be noted from the diagram that with ⅛ in. scale the metal attained a temperature of about 200 deg. above the temperature of the water; with ¼ in. something over 400 deg."

"In a locomotive firebox, the average temperature of the metal, if not protected by the water, would probably run between 2,000 and 3,000 deg. F., and with scale ⅛ in. thick and with water in the boiler, the experiments indicate that the metal including firebox ends of the tubes, can readily attain a temperature of several hundred degrees above the temperature of the water, and it is not unlikely in some cases the metal actually attains a low red heat."

THE LOCOMOTIVE PROBLEM.—Heretofore the locomotive has grown chiefly in size, weight and power, but there remains another development in the direction of crowding the greatest possible capacity for power within the possible limits of weight and size. Economy of operation, while important, is less important to-day than the provision of the utmost possible capacity of the machine. Perhaps this may be more clearly stated by saying that the greatest need is for that which will extend to the utmost the capacity of the fireman and render the limited physical strength of a man capable of supplying the requisite power.—*Mr. G. M. Basford, at Purdue University.*



7,500 GAL. TENDER TANK—CHICAGO & NORTHWESTERN RAILWAY.

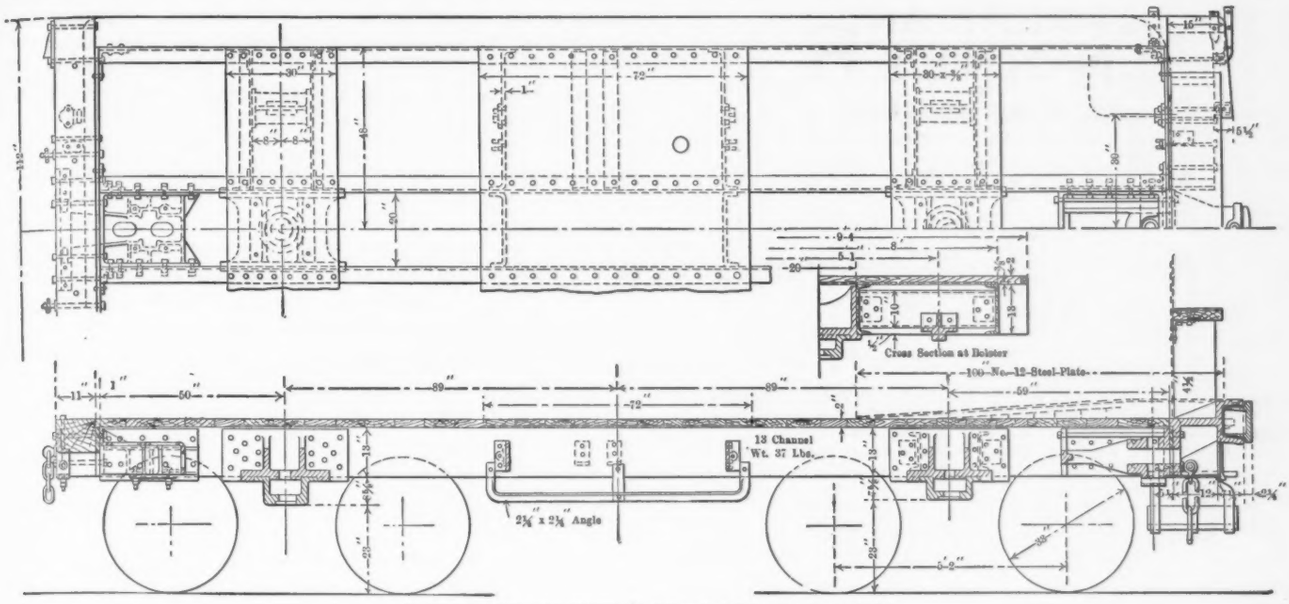
LOCOMOTIVE TENDER.

CHICAGO & NORTHWESTERN RAILWAY.

The Chicago & Northwestern Railway has just designed and is placing in service a new tender tank with a capacity for 7,500 gals. of water and 10 tons of coal. As may be seen from the drawings, the coal space extends the full width of the tank, thus making it possible to bring the entire coal supply within easy reach of the fireman. The sides and top of the tank are stiffened by 4x4-in. T's, the T's at the top being tied to those on the sides by a ¾-in. bolt, as shown in the small detail drawing. Except for these and the one baffle plate there is no cross or longitudinal brace of any kind inside the tank, nor is the bottom of the tank stiffened in any manner except at the edges, where it is attached to the sides by the 3 by 3-in. angles.

It is the custom on this road to use different heights of body center pins at the two trucks in order to have the floor at the rear end of the tank one inch higher than at the front end, thus permitting all the water to flow toward the front end. For this reason the 3-in. wrought iron drain pipes are placed as far forward as possible. The steam pipe from the engine to the train heating line is protected by a shield as it passes through the coal space. The intake is fitted with a well 14 ins. deep, the bottom of which consists of perforated plate such as is used in smoke boxes, and the sides of the well have a number of 1-in. holes punched in them as shown.

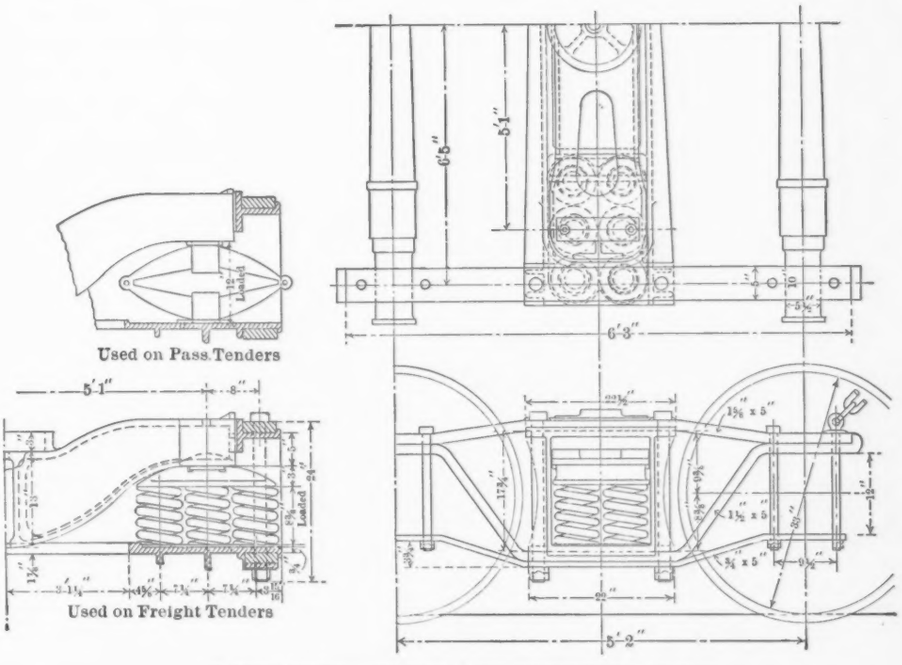
The center and side sills of the tender frame are 13-in., 37-lb. channels. The center sills are tied together at the bolsters by a heavy casting, and the center sills are connected to the side sills at this point by 10-in. channels as shown, a ⅜-in. cover plate, 30 ins. wide, extending over the top and tieing the members securely together. There is also a ⅜-in. top cover plate 72 ins. wide at the center of the frame, and, in addition, the center sills near each end of this plate are tied together by a 1 by 8-in. wrought iron U plate as shown. A spring buffer is used between the engine and the tender, and



TENDER FRAME—CHICAGO & NORTHWESTERN RAILWAY.

the drawbar connection at the rear of the tender is rigid and not equipped with spring or friction resistance. This frame, as well as the 7,500-gal. tank, is standard for both passenger and freight service. To adapt a tender frame used in one class of service for the other, it is only necessary to change the center pins, which can easily be done.

The truck, which except for the springs is standard for both classes of service, is of the arch bar type with a wheel base of 5 ft. 2 ins., and 5½ by 10-in. journals. Thirty-three-inch wheels are used in freight service and 36-in. wheels in passenger service. The transom and the bolster are both of cast steel made by the American Steel Foundries Company. The trucks for the passenger tender are equipped with elliptical springs, but may readily be adapted to freight service by substituting the helical springs and equalizing plate as shown in the drawing. We are indebted for drawings and information to Mr. R. Quayle, superintendent of motive power and machinery, and Mr. W. E. Dunham, mechanical engineer.



TENDER TRUCK—CHICAGO & NORTHWESTERN RAILWAY.

AMERICAN CAR & FOUNDRY COMPANY.—The report of the president of this company states that during the year ending April 30, 1906, it built 73,540 cars, of which 72,757 were freight and 783 passenger. Of the freight cars, 38,239 were of wood and 34,518 of steel construction. Of the 783 passenger cars 564 were wood and 219 steel. The company also made 949,951 car wheels.

TWO-STORY ELEVATED CARS.—The German Society of Mechanical Engineers offers a prize of 6,000 marks for an effective working out of a scheme for two-story cars for the Berlin elevated railroad, the upper story to be entered from special station platforms. The necessity for this arises because of through trains which pass through the city over the same tracks and interfere with the urban traffic, which requires more trains than can be put on the road.—*American Machinist.*

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.—The thirty-seventh annual convention of this association will be held at the Hotel Arlington, Washington, D. C., September 11, 12, 13 and 14. Among the reports to be considered are:

The Lustre and Life of Varnish—(To what extent is it affected by the different colors, pigments and metals? Why do varnishes lose their brilliant gloss and crack? Can remedies be applied to overcome this trouble?); Canvas Roofs for Passenger Equipment—(Is it a benefit to use felt paper under the canvas? How should a new canvas roof be painted?); The Well Equipped Sand-Blast as a Factor in the Labor-Saving Economy of the Railway Car and Locomotive Paint Shop; The Painting of Freight Equipment—(What are the best methods and most suitable colors for painting and stenciling the different classes of freight cars? What parts should be painted for their proper protection and appearance?); Is it to the Advantage of Railroad Corporations to Manufacture the Paints and Varnishes which they Consume?; The Apprentice System in the Railway Paint Shop—(Is it receiving the attention which it merits?); Brushes, their Selection, Care and Keeping.

(Established 1832).

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY
BY
R. M. VAN ARSDALE.

J. S. BONSALL,
Business Manager.
140 NASSAU STREET, NEW YORK.

R. V. WRIGHT,
E. A. AVERILL, } Editors.

SEPTEMBER, 1906.

Subscription.—$2.00 *a year for the United States and Canada; $2.50 a year to Foreign Countries embraced in the Universal Postal Union.*

Remit by Express Money Order, Draft or Post Office Order.
Subscription for this paper will be received and copies kept for sale by the
Post Office News Co., 217 Dearborn St., Chicago, Ill.
Damrell & Upham, 283 Washington St., Boston, Mass.
Philip Roeder, 307 North Fourth St., St. Louis, Mo.
R. S. Davis & Co., 346 Fifth Ave., Pittsburgh, Pa.
Century News Co., 6 Third St., S. Minneapolis, Minn.
W. Dawson & Sons, Ltd., Cannon St., Bream's Buildings, London, E. C., England.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase of construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.*

When a subscriber changes his address *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

CONTENTS.

	PAGE
Steam Motor Car, Canadian Pacific Railway	331*
Consolidation Locomotive with Alfree-Hubbell Cylinders and Valves, C., R. I. & P.	334*
Cost of Repairing Steel and Wooden Cars, Harriman Lines	337
Locomotive Repair Schedule, C. J. Morrison	338*
The Compound Locomotive	339
Steel Passenger Car, Long Island Railroad	340*
How to Make Vandyke Prints More Transparent	345
Steel Passenger Car in a Wreck	345
Heavy Six-Wheel Switching Locomotive, P. & L. E. R. R.	346*
Relative Movement of Firebox and Outer Sheets	347*
The Locomotive Problem	347
Locomotive Tender, C. & N. W. Ry.	348*
Two-Story Elevated Cars	349
Master Car and Locomotive Painters' Association	349
Improving the Output of an Erecting Shop	350
The Age of a Man	350
Suggestions Concerning the M. M. and M. C. B. Associations	351
Grey Iron Foundry, South Altoona, P. R. R.	352*
Good Work Done on Old Driving Wheel Lathes	357*
Chicago's Freight Tunnel in Operation	358
Failure of Firebox Sheets	358
Erie Fixes an Age Limit	358
Pacific Type Passenger Locomotive, N. & W. Ry.	359*
A Successful Piston Valve	361*
New Pennsylvania Steel Coach	361
The Strang Gasoline Electric Motor Car	362*
Cast Iron Car Wheels Should Be More Elastic	362
The Turbine Steamer "Lusitania"	362
Proper Salary for Proper Men	362
An Exposition of Safety Devices	362
4-Inch Pipe Machine	363*
Comparative Test of Alcohol and Gasoline	363
Briquettes as Locomotive Fuel	363
Prairie Type Locomotive With Walschaert Valve Gear, Gt. N. Ry.	364*
Comparative Test of Simple and Compound Locomotives	365
Boyce Offset Flue Sheet	365*
American Inside Moulder	366*
The Balanced Compound Locomotive	367
Personals	368
Cast Steel Pistons	369*
The World's Record in Gunnery	369
The Young Man and the Motive Power Department	369
Engine House Smoke Jacks	369
Value of Technical Papers	369
Books	369
Catalogs, Notes	370

A great deal of attention has been given to improving conditions on the machine side of the locomotive repair shop and possibly not enough to the erecting side of the shop. In some of the more progressive shops a plentiful supply of portable electric and pneumatic tools have been introduced with splendid results, and these with other devices, such as special blocking jacks, lye vats, etc., and in connection with the introduction of repair schedules and improved organization, have done much to place the erecting shop on a par with improved machine shop practice and to very materially increase the output of locomotives per pit per month. One of the first roads to introduce a shop schedule was the Chicago & Northwestern at their Chicago shops. This schedule was described on page 58 of our February, 1904, issue. and the results which were gained by its introduction were considered on page 73 of our March, 1905, issue. On page 159 of our May, 1905, issue the shop schedule in use on the Boston & Maine Railroad at the Concord shops was described. These schedules must, of course, be arranged to suit local conditions, and in every instance where they had been worked up carefully the results which have been obtained have astonished those in charge.

A schedule which has given exceptionally good results on a Western road is described by Mr. C. J. Morrison on page 338 of this issue. The shop is operated on what is known as the "gang method," and while some roads do not look upon this method with a great deal of favor, it seems to have given very satisfactory results in this instance. After all, the matter of improving the shop output depends entirely on the organization, and as labor conditions and the condition of the equipment differ in each shop, the best results can only be obtained by very carefully studying the problems involved and carefully improving the organization and introducing a repair schedule and a satisfactory cost keeping system.

THE AGE OF A MAN.

When a man is past the age of thirty-five years he is likely to begin to think of the days when he must reduce his pace, because of increasing years, and if he is a thoughtful man he is likely to be somewhat anxious as to what he will do when he is "old." After the age of forty it begins to be difficult to secure a new position for one who is unexpectedly required to do so. Young men are in demand, and few employers willingly take on any but young men.

This is perfectly natural, and to a certain extent this feeling about young men and the fear of becoming old is justified. When a man much past forty applies for a position an employer wonders why he is seeking employment if he is a good man, and if he has made proper use of his opportunities. It is quite possible that young manhood may be passed under conditions preventing the proper and natural development and advancement which one's capabilities warrant, and in the preference given to young men the employer may incur a danger of missing some excellent opportunities.

Considering workmen in the shop up to the age of, say, thirty-five, virility, spring, vigor and physical strength are likely to take the place of brain effort. Brute force is then more prominent, the tendency being to add a little speed rather than to give careful attention to the shape of tools or to use the thought and the care which counts so much towards making brute strength unnecessary. The man past thirty-five is more likely to reach for the air hoist, to look after the best possible shape of the tool and to keep the tool sharpened. He experiments in various ways to quicken the cut. He studies out and makes jigs to lay out the work, reducing unproductive time of the machine. Devices come into play to quickly set the work, and attachments are made to hold it for heavy cuts. Physical strength at this stage of life is not usually waning, but the mind is busy because of experience which has shown how a little thought may save physical effort.

At whatever age thought begins to replace thoughtless exertion of brute strength, at that age a man becomes steadier,

better and less "quick on the trigger"; at that age he is likely to listen a little less to an exhorter who has his own interests to accomplish. He is likely to think more of the real responsibilities of life and his responsible relationships towards those who furnish him work, and to think more of the home, and those in it for whom he works. When a man begins to realize that there will come a time when he cannot work at all he should, if properly intentioned and right in his life, be more valuable than ever before. At this stage he is really on the up-grade, and grows better every year to a much later age. If such a man seeks employment at your shop you may miss your own opportunity if you look at his number of years and say that you want younger men.

These paragraphs were inspired by a conversation with a most successful manager of a plant employing many men, the manager himself being, perhaps, fifty years of age. If this manager (which is impossible) should seek a new position his age would scarcely be thought of, because of his success in doing that which few are able to do, viz., direct the work of several thousand men to continually improve their efficiency and set a pace which thus far few, if any, have ever attained. That this success has been attained is largely due to a knowledge of men and the realization of the fact under discussion, which is, that men are often more valuable after reaching the age of maturity.

SUGGESTIONS CONCERNING THE M. M. AND M. C. B. ASSOCIATIONS.

There can be no question concerning the great importance of the work which has been accomplished by both the Master Car Builders' and the American Railway Master Mechanics' Associations. It is due to the efforts of the Master Car Builders' Association that freight cars may be interchanged over roads in every part of the country, and that they are operated with such a great degree of safety. The value of its work is appreciated not only by the railroads themselves, but by the Federal Government. The national laws concerning the safety devices on cars are based entirely upon the rules adopted by the Master Car Builders' Association. To the Master Mechanics' Association is due in a very great degree the many improvements in the design, operation and maintenance of locomotives and the improvement in the efficiency of the motive power department.

The importance of the investigations pursued by these associations is many times greater than it was a few years ago, when the number of cars and locomotives was very much smaller and the railroads were not forced to operate them with as great a degree of economy as at present. In spite of the greater importance of the work which is being carried on, we find that the amount of time which is devoted to the discussion of the various subjects by these associations is not any greater now than it was when very much less work was handled, and the method of holding the convention is much the same as formerly. If the associations are to keep up their good work it would seem that they must be handled in a very different manner from what they are at present.

In the first place, the committee reports and individual papers should be sent to the secretary of the association early enough so that he can place copies of them in the hands of every member of the association at least three weeks before the convention. Even this is not time enough for the average member to properly read and digest such of the reports as he is especially interested in. It requires considerable effort on the part of the motive power officer to get his work into such shape that he can attend the conventions, and if the papers do not reach him until only a few days previous to his leaving the rush of work is so great that he cannot give them the proper amount of time and attention. It is a lamentable fact that members very often take up considerable time upon the floor which might very well have been saved if they had had time or taken the pains to study the report carefully.

Every report or paper, unless it is extremely brief, should be presented in abstract. These abstracts should be very brief, and the time for presenting them should be limited to a very few minutes. Under ordinary circumstances they should be read by the secretary of the association, or if by a member of the committee, he should be a proficient reader, with a good, strong voice. At the recent conventions most of the reports were read entire, and in most cases where it was attempted to present abstracts they were entirely too long. In some instances the reports were so poorly read that only a few people within a short distance from the reader were able to follow him, and then it required an effort. The noise made by the squeaking of the chairs, the passing of the members back and forth over the bare floor, and the noise from the exhibits outside of the meeting room, added in many instances to poor reading, were extremely disagreeable features. In many instances a large number of the members present paid very little attention to what was going on while the report was being read, and acted as if they were very much bored until the reading was closed and the discussion opened.

Apparently the members who took the most active part in the discussions were those who had had time to study the reports beforehand. The reading was, therefore, not of much interest to them. The other members, unless they were extremely familiar with the subject, could not gain much from the hurried reading in the convention. In order to have the abstracts uniform and suitable it would doubtless be a good idea to have the secretary of the associations prepare them.

A feature which should be strongly condemned, and which should be carefully guarded against in the future, is that of having a report read by title and passed without discussion, owing to lack of time or the absence of the members of the committee who drew up the report. Nothing should be allowed to interfere with the program as arranged by the executive committee. The proper consideration of the reports, many of which involve considerable investigation, which is carried on at a great expense to the railroads upon which the tests are conducted, is of very much greater importance than any features of entertainment which may be provided, and these features should not be allowed to interfere with the program as arranged by the executive committee.

There is no question but what the discussions would be very much more valuable if the meetings were held in a room with good acoustic properties and far enough from the exhibits so that the noise made by them will not interfere. More machinery and equipment in operation is shown at each succeeding convention, and the noise made by such exhibits is becoming greater each year. It is not necessary for the meeting hall to be so placed that members must pass by the exhibits in going to and from the meeting. In most instances the members are just as anxious to see the exhibits as the exhibitors are to have them.

The executive committee should also see that comfortable chairs are provided. Many of the members wish to remain in the convention during the entire session, and if conditions are at all favorable will do so. It must be admitted that sitting on a folding chair for three or four hours or more is not the most comfortable thing in the world, and if such chairs are squeaky and make a racket every time a man changes his position it is rather disconcerting. It often becomes necessary for a member to leave during the session, and supply men often wish to come in to hear the discussion of the reports in which they are specially interested, and in order that such movements may be made without disturbing the meeting rugs, or some suitable covering, should be placed upon the floor, at least upon the aisles. The attendance at the conventions seems to be increasing, and the seating capacity in the meeting room at the last convention was in several instances not large enough to accommodate those present.

If these associations, of which we may well feel proud, are to improve and progress in line with the growth and increasing importance of the motive power department, immediate measures should be taken to improve such conditions as those mentioned above.

SOUTH ALTOONA FOUNDRIES.

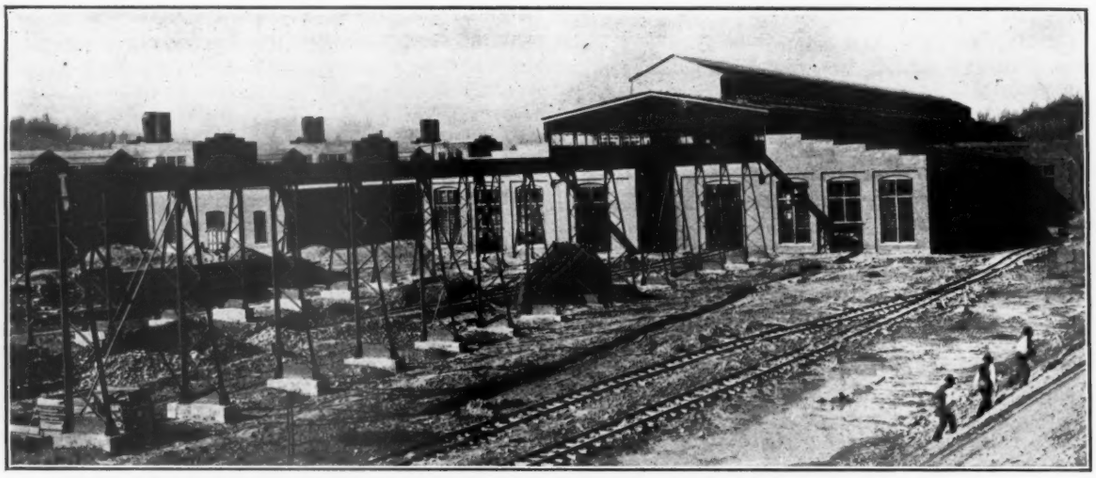
PENNSYLVANIA RAILROAD.

(*Continued from page* 126).

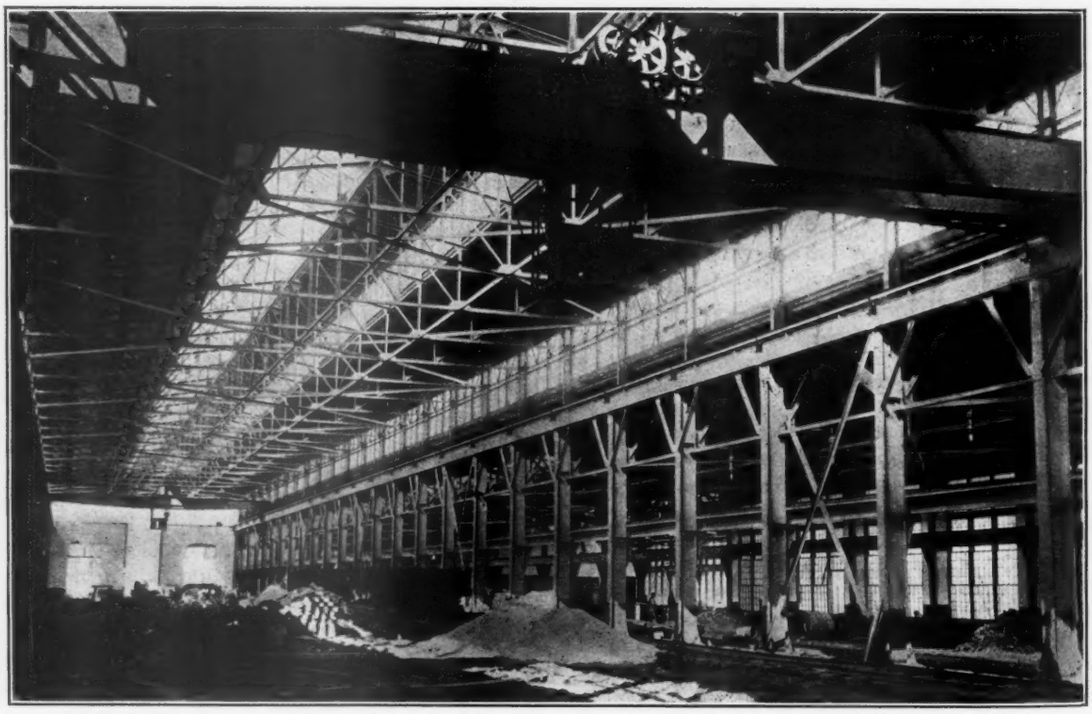
GREY IRON FOUNDRY.

The main structure is about 564 ft. by 163 ft.; it has an extension on one side about 444 ft. long by 60 ft. wide, which contains the office, wash room, sand mixing room, core room and a room for the temporary storage of patterns. The illustrations give some idea of the structural steel work and of the splendid daylighting. The main part of the building is divided into three longitudinal bays. The two side bays are 45 ft. wide, and are spanned by 5-ton electric traveling cranes, which are operated from the floor. The center bay is 70 ft. wide, and is spanned by one 25 and two 12½-ton electric traveling cranes, the runways of which extend 280 ft. beyond the building at each end. The ends of the building are so arranged that these traveling cranes may run out on this extended runway, beneath which are stored the flasks and heavy castings. The brick walls, except for a doorway 12 ft. wide at the center, are carried up to the height of the crane runway, and above this the opening is closed by a lifting door, which extends across the entire width of the bay. This door is made of corrugated steel, and is arranged to swing inward and upward, the mechanism being operated by an electric motor. In addition to these cranes there are a number of 5-ton jib cranes attached to the columns along the sides of the center bay, resting on pintles so that they can be moved from one column to another by the overhead traveling crane.

There are two 96-in. cupolas which have a capacity of 18 tons an hour. It was the intention to provide four of these, as shown on the drawing, but only two have been installed, one at each end. The cupola at the center is smaller, and is used principally for cylinder iron. The arrangement of the blowers, cupolas and charging rooms is practically the same as those in the wheel foundry. That part of the west bay which lies between the cupola and the end of the foundry nearest the pattern shop will be devoted entirely to an extensive installation for the machine moulding of small castings. The waste sand will drop down through iron grates and will be conveyed to a sand mixing machine made by the Standard Sand & Machine Company of Cleveland. This machine mixes

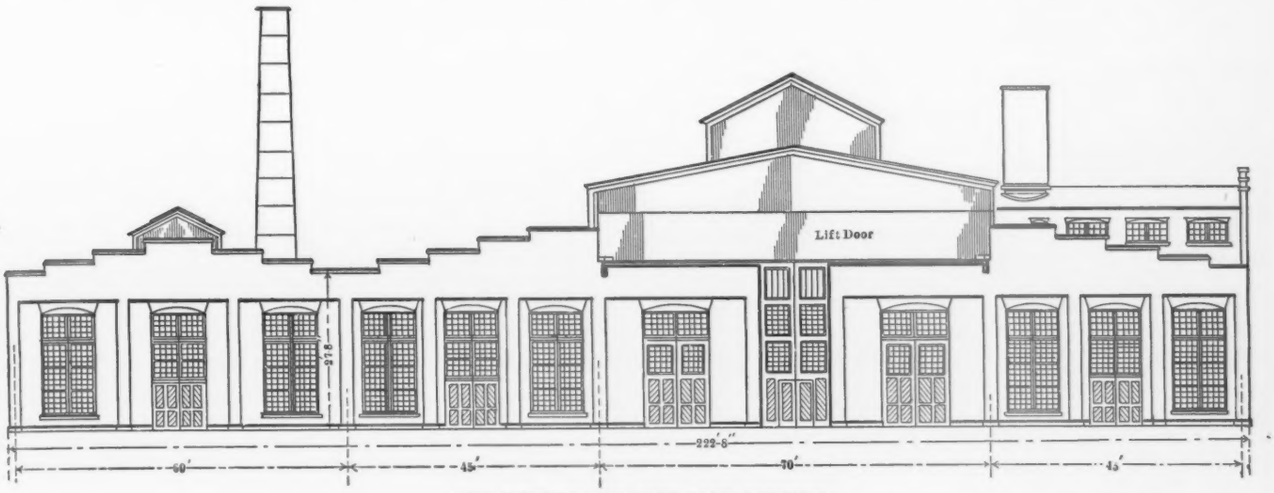


GREY IRON FOUNDRY, WITH WHEEL FOUNDRY AT THE LEFT—SOUTH ALTOONA FOUNDRIES.

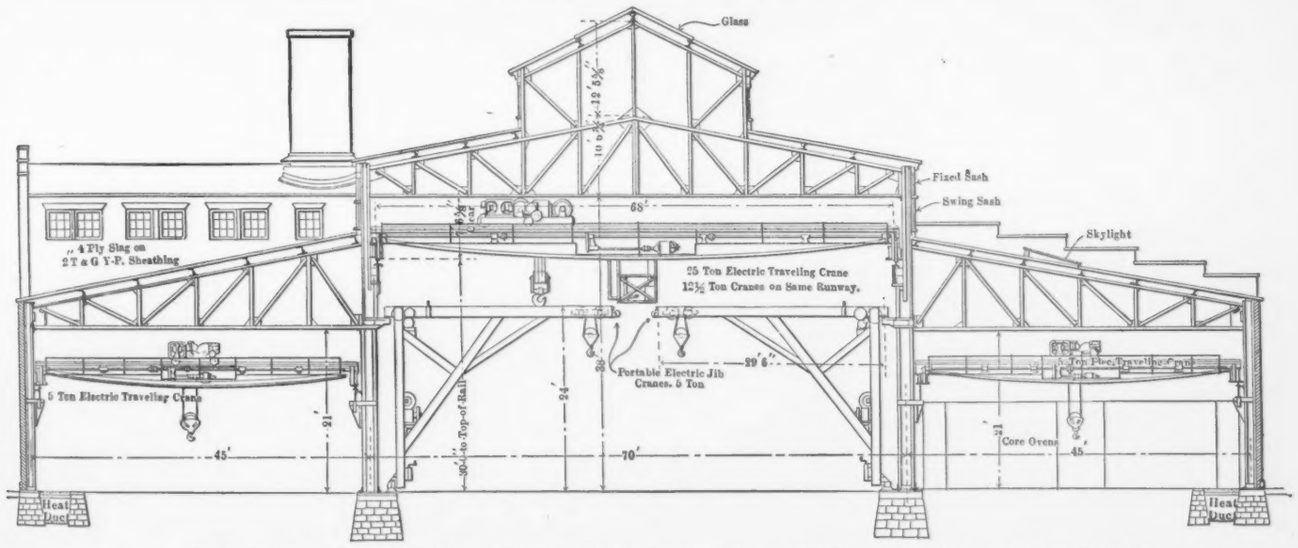


INTERIOR OF THE GREY IRON FOUNDRY—SOUTH ALTOONA FOUNDRIES.

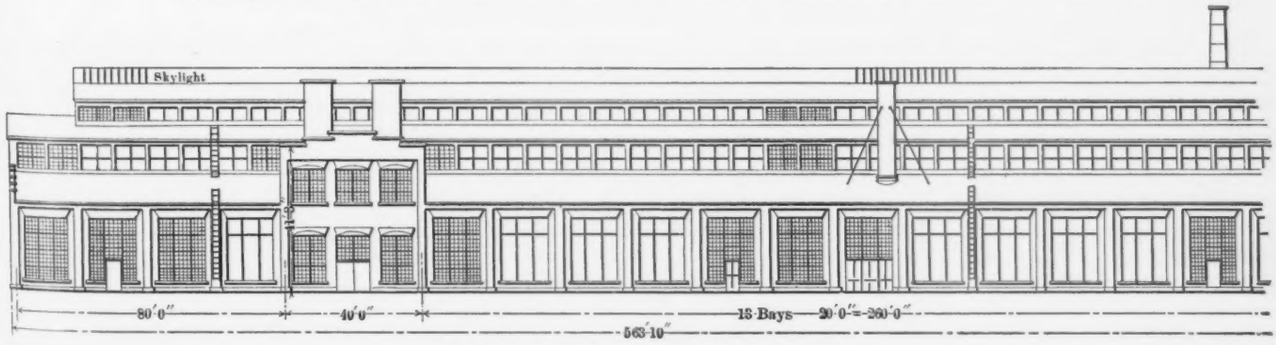
and cleans the sand and conveys it overhead, from whence it will be fed down through spouts to the moulding machines. The other end of the foundry is given over entirely to the cleaning of the castings; in it are four batteries of tumblers, each containing three units; each battery is driven by a 20-h.p. motor. All the cleaning is done over a grated floor, and the burned sand drops through into a tunnel and is received by small cars. These are hauled out when they are filled by a small electric locomotive. The track from the tunnel runs to a trestle near the office building, where the cars are dumped into wide-gauge cars without rehandling the material.



END VIEW OF THE GREY IRON FOUNDRY.



CROSS-SECTION OF GREY IRON FOUNDRY—ADDITION CONTAINING OFFICE, CORE ROOM, ETC., NOT SHOWN.



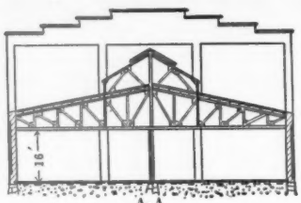
PART SIDE VIEW OF GREY IRON FOUNDRY.

The core ovens are located in the east bay, adjacent to the core room. The furnaces for these ovens are located below the floor level. The shelves for the cores are on cars, and the tracks extend out into the core room. Below the core room, which has a cement floor, are sand storage bins, from which the sand is raised in narrow-gauge cars by an hydraulic elevator. The core benches and the core racks are built entirely of steel, as shown in the illustrations.

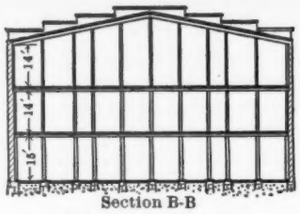
The sand mixing room is equipped with an electric driven sand mixing machine made by the Standard Sand & Machine Company. The sand is raised from the storage room in the basement by an hydraulic elevator, and is emptied into overhead storage bins, and from these it is fed into the mixing hopper of the machine. After being properly mixed and cleaned it is conveyed to storage bins. A room, 60 by 100 ft., adjacent to the core room, is used for the storage of patterns which are in use in the foundry.

The wash room, 60 by 120 ft., is equipped with metal lock-

End elevation and section of Pattern Shop

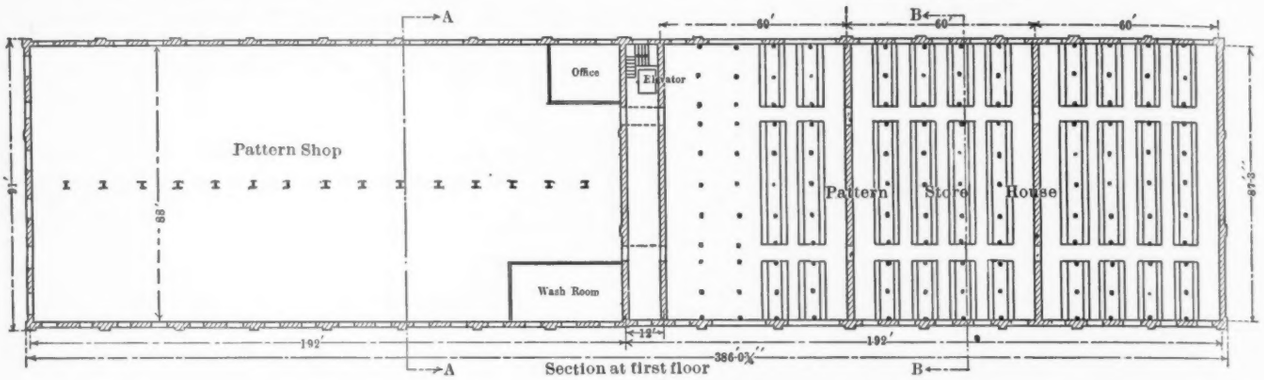


A-A

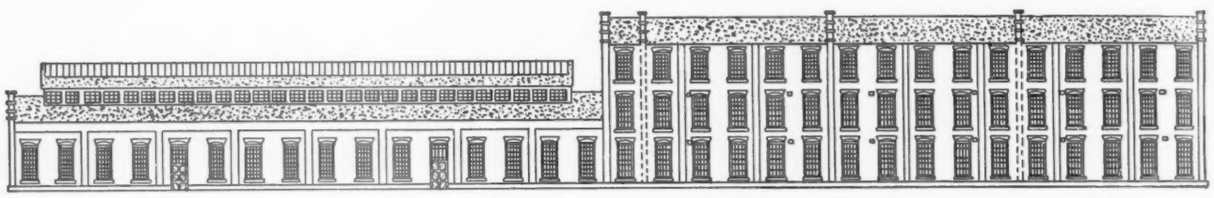


Section B-B

Pattern Store House



Section at first floor

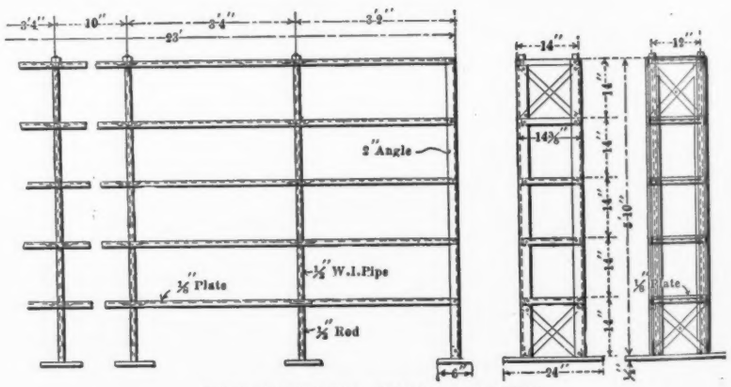


PATTERN SHOP AND PATTERN STORAGE BUILDING.

ers, shower baths and large porcelain wash basins, with hot and cold water faucets. The room is well lighted and has a cement floor.

PATTERN SHOP AND STORAGE BUILDING.

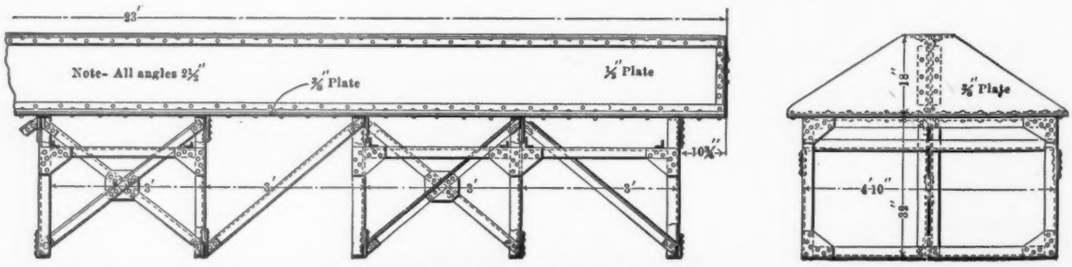
This is a brick building, 91 by 386 ft. The section occupied by the pattern shop is one story high (16 ft. from the floor to the underside of the roof trusses) and 193 ft. long, while the pattern storage section is 180 ft. long and three stories high. The framework of the pattern shop is of steel. A large portion of the side walls is glass, and this, with the windows in the sides of the clerestory and the skylights, provides splendid daylighting. The benches are placed along the side walls and the machines are grouped in the middle of the shop. The larger machines are driven by General Electric 230-volt shunt wound individual motors. These are enclosed to protect them from the dust and shavings. The smaller tools are grouped together and driven by a 20-h.p. General Electric motor, which is supported above the roof trusses. Following is a list of the machine tools and motors:



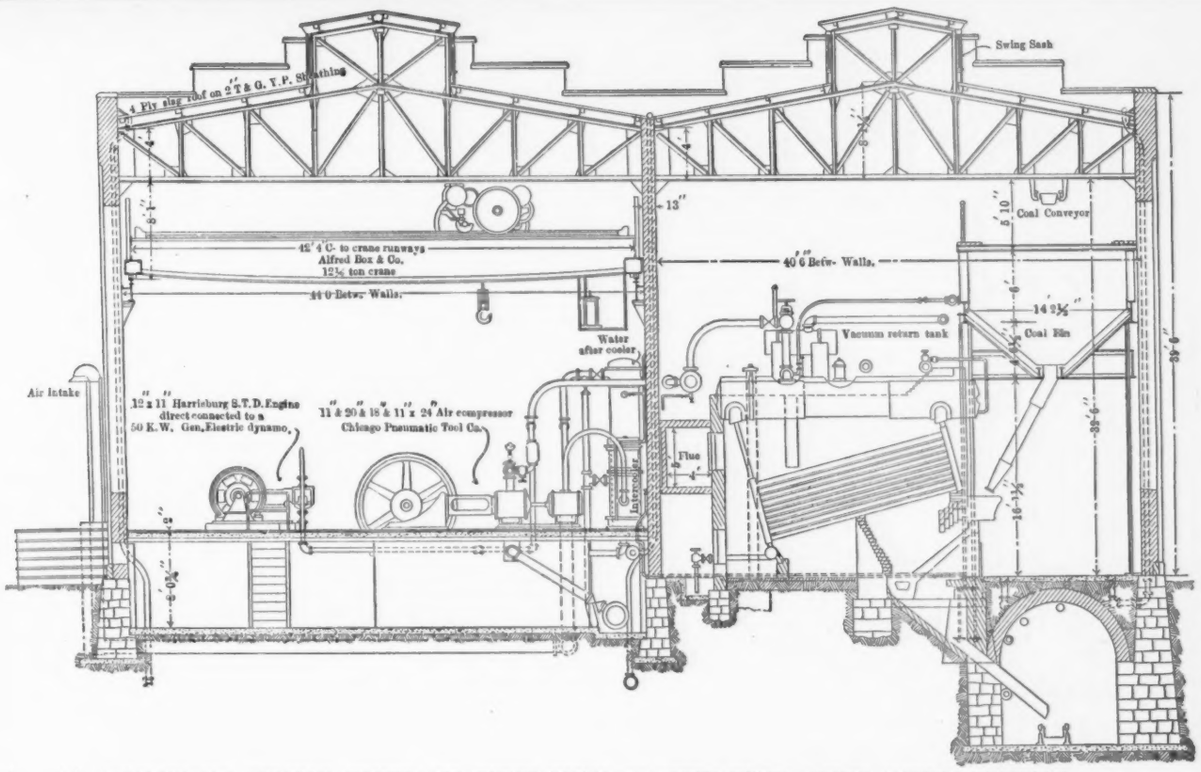
STEEL RACKS FOR STORAGE OF CORES.

LIST OF PATTERN SHOP MACHINERY.

Name.	Size of Motor.
Rip saw, 36 by 72 in. table, P. R. R.	5½ h.p.
Rip saw, 48 by 76 in. table, L. Wright	3½ h.p.
Band saw, Berry & Orton	2½ h.p.
Band saw, type B, with ½ in. saw blade, Oliver	3½ h.p.
Putnam lathe, 25 and 50 in. swing, 8 ft. bed	25 h.p.
Power band saw filing and setting machine, Atlantic Works	
Drill press, P. R. R.	
Crane core box machine, J. A. Crane & Co.	
28 in. grindstone	
30 in. automatic knife grinder, No. 40, Springfield Mfg. Co.	
20 in. by 6 ft. 9 in. lathe, P. R. R.	
30 in. by 11 ft. lathe, P. R. R.	
30 in. by 22 ft. lathe, P. R. R.	
90 in. face lathe, P. R. R.	
Band saw, type B, with ½ in. saw blade, Oliver	3½ h.p.
Oliver Universal saw bench, 14 in. saw	3½ h.p.
Oliver Universal saw bench, 14 in. saw	3½ h.p.
20 in. hand planer and jointer, Oliver	3½ h.p.
Buzz planer and jointer, L. Power & Co.	3½ h.p.
24 in. heavy planer and surfacer, Atlantic Works	5½ h.p.
Oliver face plate lathe, type D	3½ h.p.
30 in. planer, R. Ball & Co.	5½ h.p.



STEEL BENCHES FOR CORE MAKERS.



CROSS-SECTION THROUGH ENGINE AND BOILER ROOMS OF POWER HOUSE—SOUTH ALTOONA FOUNDRIES.

HAND MACHINES.

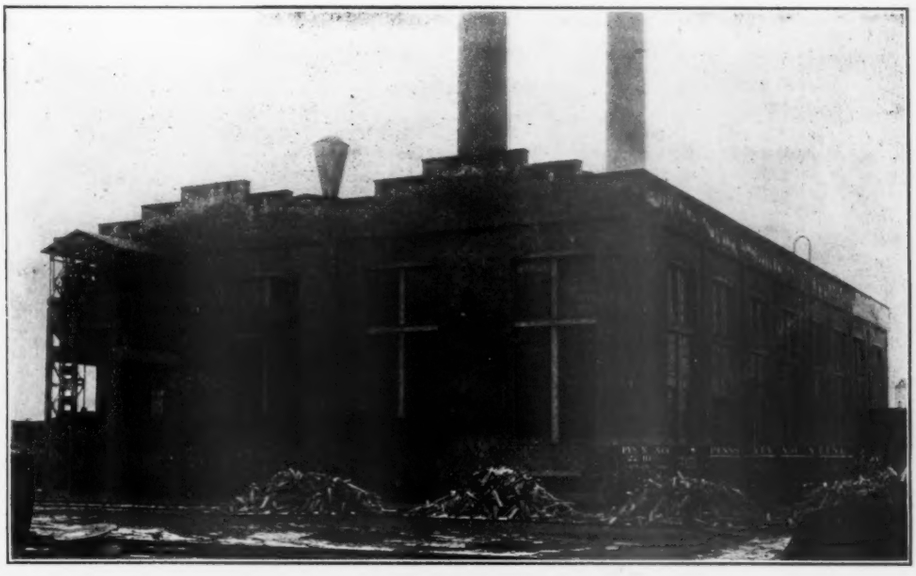
4 —No. 3 Oliver wood trimmers.
10—No. 1 Universal wood trimmers, American Woodworking Machinery Co.
4 —No. 4 Wood trimmers, Smith & Egge.

The shop is lighted by 32 enclosed arcs, and each work bench is provided with a 16-candle power incandescent light.

The pattern storage section is separated from the pattern shop by a 12-ft. hallway, which contains the elevator and stairways. The framework of this part of the building is of heavy timber construction. It is divided by brick walls into three sections, and the doors between these sections are of steel and are normally closed.

This department is equipped with a very complete telephone service. The men in charge have different numbers, and when they are called up every 'phone in the department sounds the number, so that a man can very quickly and easily be located. This part of the building is also equipped with sprinkler service, which is operated by valves placed outside of the building. Openings are made in the side walls at each floor to prevent the floor from being overloaded in case one of the rooms is flooded. Each section is also provided with fire extinguishers and fire hose. This part of the building is lighted by incandescent lights.

All of the patterns except the very large ones are stored on shelves, and are so arranged that they may readily be located by means of a card index system, and can easily be returned to their proper place on the shelves. A narrow-gauge track extends from this department to the foundries, as may be seen by reference to the general plan (page 122).

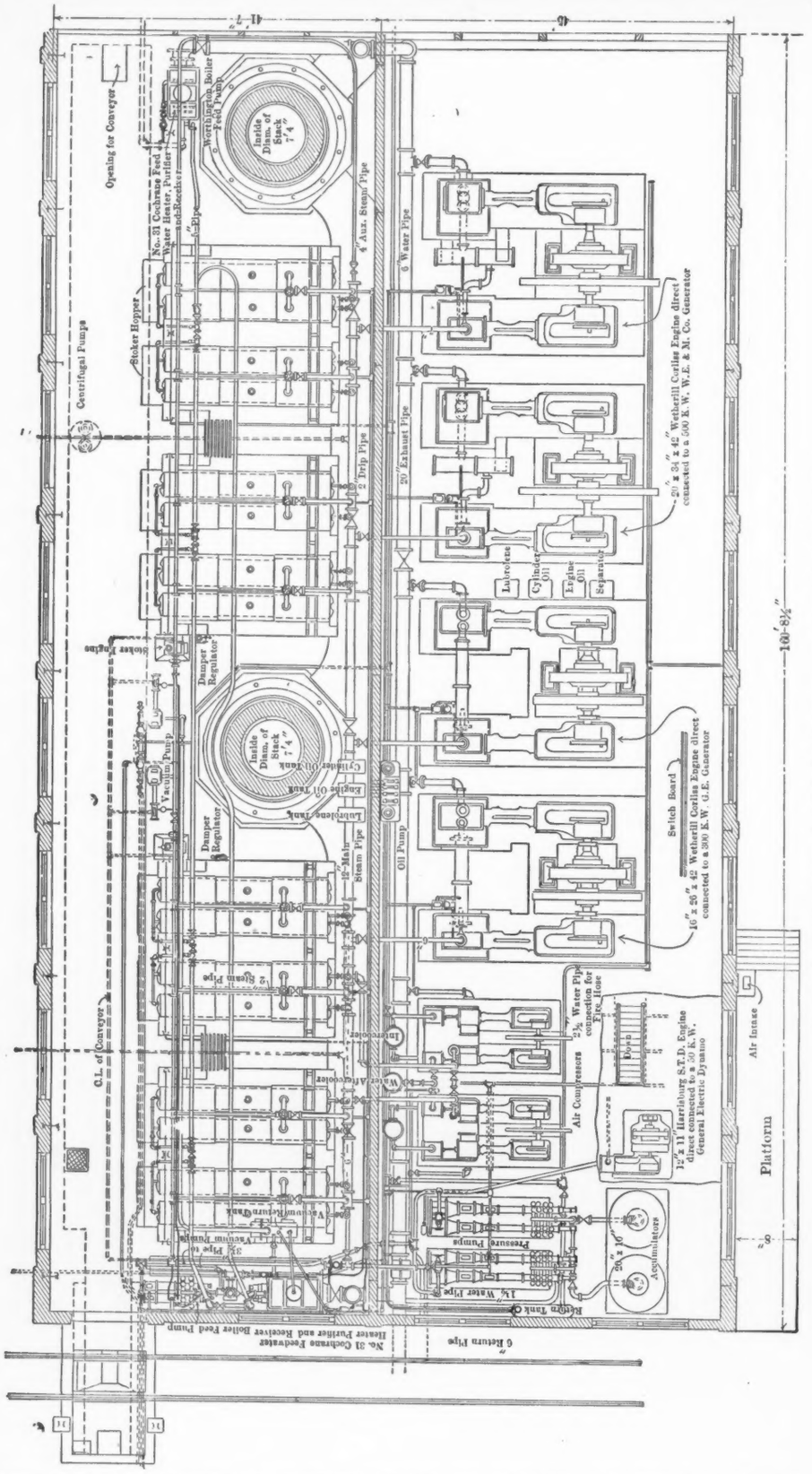


POWER HOUSE.

PATTERN SHOP AND PATTERN STORAGE BUILDING.

POWER HOUSE.

The power house is located at about the centre of gravity of distribution when the brass and steel foundries will have been added to the present installation. The building has concrete foundations, brick walls and steel frame, and one end has a temporary wall of corrugated



PLAN OF ENGINE AND BOILER ROOMS—SOUTH ALTOONA FOUNDRIES.

iron, so that it can readily be extended when the plant is enlarged. The house is divided by a 13-in brick wall into a boiler room 44 ft. wide and an engine room 40 ft. 6 ins. wide.

In the boiler room are eight 261-h.p. Babcock & Wilcox boilers equipped with Roney stokers. The draft is furnished by two steel stacks, 7 ft. 4 ins. inside diameter and 175 ft. high. Coal is delivered directly from hopper bottom cars to a Link Belt conveying apparatus fed by a reciprocating feeder, and is stored in a large continuous steel bin above the boilers, from which it is fed to the stokers. The conveying and coal-crushing apparatus is driven by two 10-h.p. motors installed in the boiler room basement. The ashes are conveyed to a bin above the coal delivery track, and are loaded from this directly into hopper cars. Two 3-in. motor-driven centrifugal pumps drain the water collected in sumps in the ash tunnel below the sewer level. The boilers are fed by three 12 by 7½ by 10-in. Worthington boiler feed pumps. The feed water is heated by two No. 31 Cochrane 1,700-h.p. feed water heaters, purifiers and receivers. Two 8 by 14 by 16-in. vacuum pumps are used in connection with the Warren-Webster system of steam circulation.

In the engine room are two 20 and 34 by 42-in, Wetherill-Corliss engines, direct connected to 500-k.w. Westinghouse generators, and two 16 and 26 by 42-in. Wetherill-Corliss engines, direct connected to 300-k.w. General Electric generators. These supply current for power and lighting at 230 volts. For light loads a 12 by 11-in. Harrisburg standard engine, direct connected to a 50-k.w. General Electric dynamo, is provided. Compressed air at 80 lbs. pressure per sq. in. is furnished by two 11 and 20 and 18 and 11 by 24-in. Franklin air compressors. Hydraulic pressure at 525 lbs. per sq. in. for operating the elevators and for the wheel breakers and hot metal reservoirs is furnished by two Epping-Carpenter 8 and 12 and 20 and 4¾ by 16-in. pressure pumps in connection with two 20-in. by 10-ft. accumulators. The engine room is equipped with an Alfred Box & Company 12½-ton electric traveling crane, 42 ft. 4 ins. span.

The piping is very carefully designed and arranged to take care of almost any emergency. A 4-in. auxiliary header feeds the vacuum pumps and stoker engines, and in case of emergency can supply steam to part of the engine room equipment. The boiler feed pumps are supplied with steam from the drip line from the main steam headers. The system of drip piping is so arranged that each "T" in the main steam header is drained on its underside through a 1-in. nipple and valve into a 1½-in. drip line; this 1½-in. line has a uniform fall to the end of the power plant building, where the mixture of steam and water is deposited in a vertical drum, the lower end of which is drained by means of automatic traps provided in duplicate and by-passed, the water discharged from the traps being blown up into the heater and also arranged to be sent

to the sewer in case the heater should be closed down for repairs. From the top of the aforementioned drum the steam is conveyed to each of the boiler feed pumps, which are also supplied through branches from the auxiliary steam main, these latter branches, however, being normally shut off, so that all the steam supplied to the boiler feed pumps must be taken through the drip line. By this means a positive circulation of steam and water through the various drip connections is ensured, and at the same time the feed pumps are always supplied with steam during the operation of the plant.

Engine oil, cylinder oil and lubrolene for the air compressors are supplied from tanks in the boiler room 19 ft. above the engine room floor. The oil is returned to these tanks by 3 by 2 by 3-in. Worthington pumps, which may be driven by either steam or compressed air. There are four of these pumps, two for engine oil and one each for the cylinder oil and lubrolene. The tanks are closed, so that the pumps can force the oil by any obstructions. Overflow of the pumps indicates that the overhead tanks are full. The engine oil is filtered before being returned to the overhead tanks.

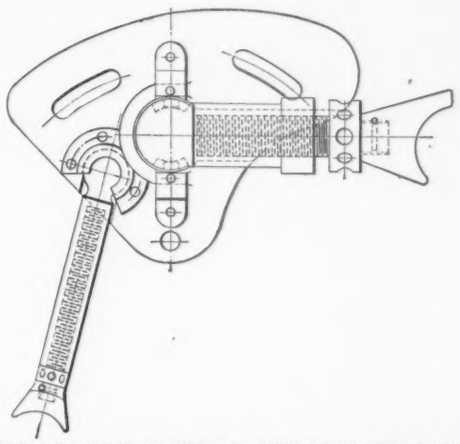
The piping and electric wires are carried from the power house through a concrete tunnel to the different buildings. The sizes of the pipes at the power house end of the tunnel are 4-in. air, 6-in. steam, 5-in. hydraulic, 6-in. hydraulic return, 20-in. exhaust and 6-in. drip.

GOOD WORK DONE ON OLD DRIVING WHEEL LATHES.

From time to time we have called attention to the splendid work being done by the latest designs of driving wheel lathes. The improvement in the design and operation of these lathes has been so rapid that the best ones which could be purchased four or five years ago are now spoken of as old machines. While recently visiting a shop which was equipped with the best driving wheel lathes on the market five years ago the shop superintendent passed them by with the remark: "These are old wheel lathes, and, of course, cannot be expected to do the work done by those of more recent design. We expect in the near future to replace two of them with one of the new ones."

This same shop superintendent frankly admitted, however, that, due to improved shop conditions, the use of high-speed steel, improved methods of handling the wheels in and out of the lathe, and a few changes in the design of the machines, they were at present turning out at least three times as much work as when they were first placed in service. An instance where splendid results were obtained after making a few changes in the design of an old lathe and the method of holding or clamping the wheels, was described on page 299 of our August issue.

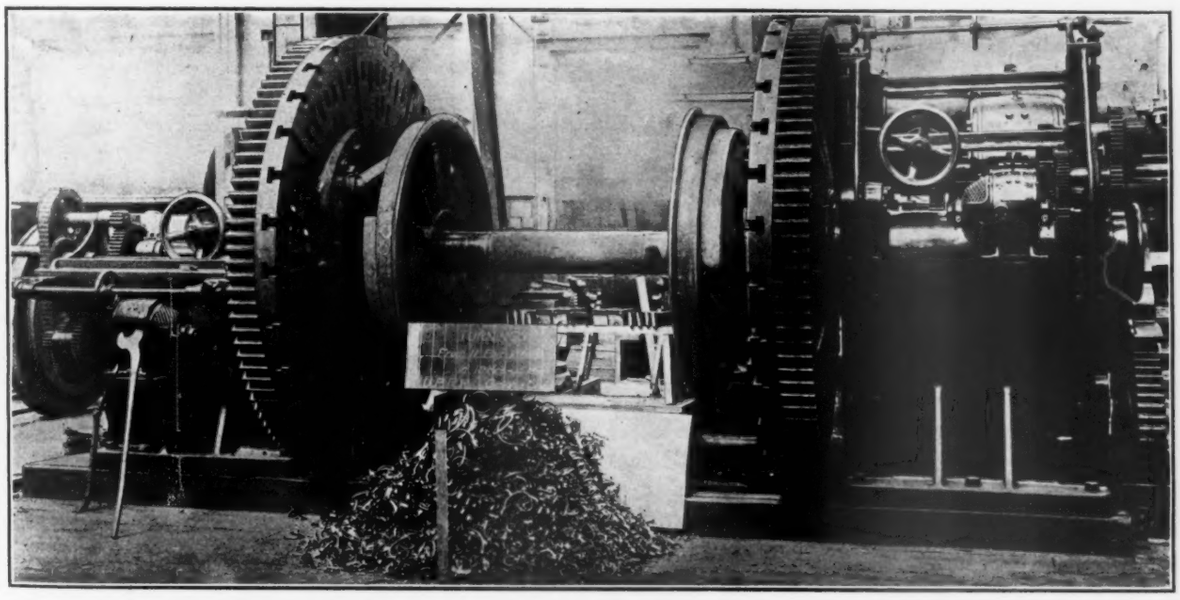
The work being done on a 69-in. Niles driving wheel lathe, of comparatively light design, which has been in service at the East Moline shops of the Chicago, Rock Island & Pacific Railway about two and a half years, was recently called to our attention. The lathe is driven by a 15-h.p. variable speed motor. Holes have been cut through the face plates for the crank pins, and the traversing screw, which operates the rear head, has been changed from a 4 to a 1-in. pitch, double thread, in order to allow the head to be moved backward and forward more quickly. This latter change was made after the record run, noted below, was made



FOX AND WARE DRIVER FOR DRIVING WHEEL LATHE.

The lathe is also equipped with special drivers for holding the wheels, which are shown in the accompanying illustration, and which have been patented by Mr. E. O. Ware, machine shop foreman at East Moline, and Mr. F. E. Fox, master mechanic of the Rock Island at Cedar Rapids, Iowa. Two drivers are placed on each face plate, one of them having two adjustable arms, as shown in the illustration, while the other has only one. The forked end of the arm fits against the rim of the wheel at its junction with one of the spokes. The heavier arm on the double driver is adjusted to resist the stress due to cutting. The purpose of the lighter arm which grasps the wheel in the opposite direction is to hold it rigidly in place and prevent chattering.

In a test of this lathe 10 pairs of driving wheels were turned in 10 hrs. 19 min., 1,665 lbs. of metal being removed. The first four pairs were Standard steel, 48½ ins. in diam



90-INCH NILES DRIVING WHEEL LATHE, OMAHA SHOPS—UNION PACIFIC RAILROAD.

eter. On two of these the feed used was ⅜ in., the depth of cut 5-16 in., and the cutting speed varied from 11 to 20 ft. per min. On the other two the feed used was ¼ in., the depth of cut 5-16 in., and the cutting speed varied from 13 to 16 ft. per min. The other six pairs of drivers were of Midvale steel, 58 ins. in diameter. On two pairs of these a feed of ¼ in. was used, depth of cut 5-16 in., and a cutting speed of from 14 to 18 ft. per min. On the other four the feed was ¼ in., depth of cut ¼ in., and cutting speed 14 to 18 ft. per min., although in one instance it ran as high as 20 ft. per min. From the detail report it would appear that the various tool steels which were used in the test were pretty badly punished.

Another test of an old driving wheel lathe, which has had several improvements made to it, recently took place in the Omaha shops of the Union Pacific Railroad Company. This is a Niles 90-in. lathe, driven by a 15-h.p. motor, and has been in service for the past four years. It is also equipped with the Fox and Ware drivers described above. Previous to the test the feed gear was redesigned to increase its capacity, the bearings were thoroughly examined and all slack taken up, holes were bored in the face plate to take the crank pins, and the movable face plate was equipped with a motor and chain drive.

TEST OF OLD 90-INCH DRIVING WHEEL LATHE—OMAHA SHOPS, UNION PACIFIC RAILROAD COMPANY.

Diam. of wheel centers. Ins.	Cutting speed, ft. per min.	Amt. of feed. Ins.	Depth of cut Ins.	Size of tool. Ins.	Time of cutting. Min.	Time chg. wheels. Min.	Amt. of metal remov. Lbs.	Total time. Min.
55	18	⅜	⅜	2½ x 1½	50	13	177	63
55	18	⅜	⅜	2½ x 1½	51	11	174	62
55	18	¼	¼	2½ x 1½	56	12	188	68
50	15	⅜	⅜	2½ x 1½	57	11	178	68
50	15	⅜	⅜	2½ x 1½	50	7	182	57
50	15	⅜	5/16	3 x 1½	48	14	173	62
50	15	⅜	5/16	3 x 1½	55	10	188	65
50	15	⅜	⅜	3 x 1½	55	5	184	60
44	12	⅜	¼	2½ x 1½	30	5	169	35
44	12	⅜	¼	3 x 1½	35	5	175	40
44	12	⅜	¼	2½ x 1½	30	5	172	35

Total time, 10 hrs. 15 mins. Average time per pair, 55.9 mins. Total amount of metal removed, 1,960 lbs.

In a test made on June 14, details of which are presented in the accompanying table, 11 pairs of wheels were turned in 10 hrs. 15 min., 1,960 lbs. of metal being removed.

These tests certainly demonstrate that with a few changes in the design, and proper care and attention, the wheel lathe of four or five years ago can do much better work than is generally obtained from it in the larger percentage of shops in which it is installed. Its design is, of course, such that it cannot compete with the more recent designs as far as the size of the cut is concerned, as a comparison of these records with that of the New York Central lathe at West Albany, as recorded on page 74 of our February, 1906, issue, will show. By using higher cutting speeds, however, possibly at the expense of the tool steel, the records on the lighter machines are very favorable. Just how long the lighter lathes would stand up under this kind of treatment is, of course, a question, but where it was necessary to keep them working at this pace, or even a considerably slower one, for any length of time, it would probably make a great enough saving to enable the railroad company to scrap the machine with good grace. These results must, of course, be considered in the light of special tests or records, and not as of everyday occurrence. They do, however, indicate that much more may be obtained from the older designs than is ordinarily expected of them.

CHICAGO'S TUNNEL ROAD IN OPERATION.—The Illinois Tunnel Company has put into operation its 45 miles of freight tunnel tracks under Chicago's streets. The company has finished connections with 30 buildings in the downtown district. Connections have already been made between the freight and warehouses of nine of the principal railroads. Others are under way. Work was begun five years ago, but legal complications hindered the operation of the unique underground railway.—*Railway World.*

FAILURE OF FIREBOX SHEETS.

The following is taken from a paper on Firebox Steel presented by Mr. Max H. Wickhorst before the recent meeting of the American Society for Testing Materials:

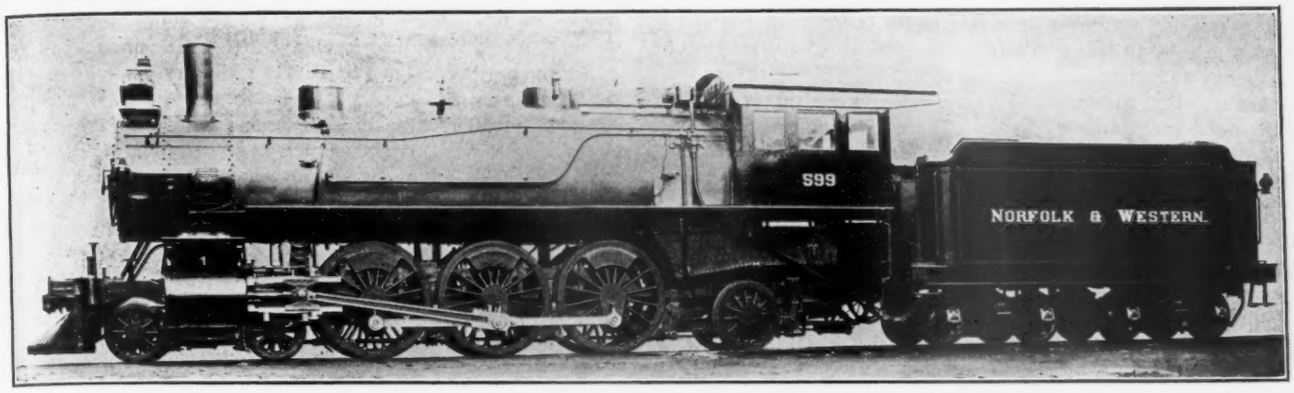
In general, firebox sheets fail in one of two ways; first, gradual failure; the sheet may have a good many small cracks, which are mostly in a vertical direction. These cracks are thickest radiating from the stay bolts and frequently run from one stay bolt to another in the same vertical row, but never between stay bolts horizontally. They are almost always on the fire side and at times extend through the thickness of the sheet, first going through next to the stay bolts. Such sheets are generally accompanied with more or less corrugation, and the cracked and corrugated condition is almost always confined to the lower half of the sheet. Second, sudden failure, or rupture; the sheets may fail by a single crack or rupture from a foot to several feet long. In bad cases, the crack may extend from the mud ring to the crown sheet, but ordinarily the crack is confined to the lower half of he sheet, extending upward from the mud ring or from a few inches above it, and is always near the middle of the side sheet longitudinally. Such sheets may show no corrugations and may show very little if any other defects.

About two years ago a lot of records and papers concerning failures of firebox sheets were gathered out of the files in the superintendent of motive power's office of the Chicago, Burlington & Quincy Railway, Lines East of the Missouri River, and a classification made of the conditions under which the failures occurred, with results as shown below. These failures include only those occurring in the second class mentioned above, or ruptures.

	Number.	Per cent.
Washing—Cooling	3	7.7
" Using nozzles	16	41.0
" Filling	2	5.1
" After filling	7	17.9
In shop or house, cold	7	17.9
In house, hot	2	5.2
Discovered arriving at terminal	2	5.2

It will be noted from the above that 71.7 per cent. occurred while the engine was being washed, this including 41 per cent where nozzles were being used at the time; 17.9 per cent. occurred while the engine was cold, under other circumstances, making a total of 89.6 per cent. for the failures while the engine was cold. This leaves 10.4 per cent. for failures while the engine was hot, but it is not improbable, if full details of the conditions attending the failures in these latter cases were at hand, that in some or perhaps all, the records would show the engine had been cold. When washing the boilers, cold water had probably been used in all cases, and the above figures would seem to argue very strongly in favor of keeping the boiler continuously hot, and the use of a method of washing where the boiler does not get cold, say not below 150 degrees F.

ERIE FIXES AN AGE LIMIT.—Superintendent Sharpe, of the Susquehanna Division of the Erie, has issued a notice that hereafter persons seeking to enter the employ of the company in either the train, engine, station, signal or switching departments, or as telegraph operators, clerks or stenographers, must not be more than 35 years old. The same maximum age limit is announced for messengers, rivet heaters, mechanics and helpers, while apprentices must not be older than 21 years. Roundhouse men may apply up to 40 years of age, and stationary engineers, firemen and car-track repairers may be taken on up to 45. The highest age limit allowed is 50 years, and this applies only to outdoor laborers and freight handlers.—*Railway World.*



SIMPLE PACIFIC TYPE PASSENGER LOCOMOTIVE—NORFOLK & WESTERN RAILWAY.

PACIFIC TYPE PASSENGER LOCOMOTIVE.

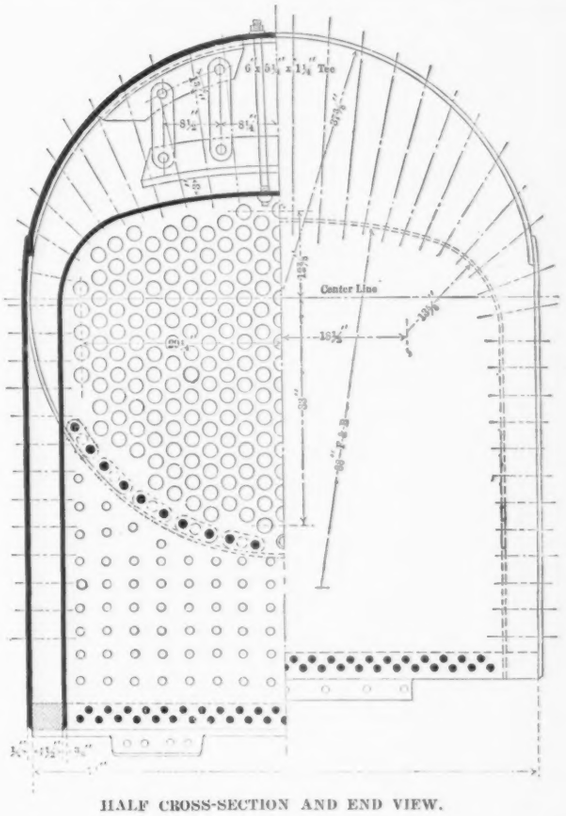
NORFOLK & WESTERN RAILWAY.

The American Locomotive Company recently delivered from its Richmond shops an order of five Pacific type locomotives to the Norfolk & Western Railway, which form an example of the value of increased boiler capacity for handling heavy trains on a high schedule over difficult grades, as they replace engines of the same size cylinders and wheels but with smaller boilers.

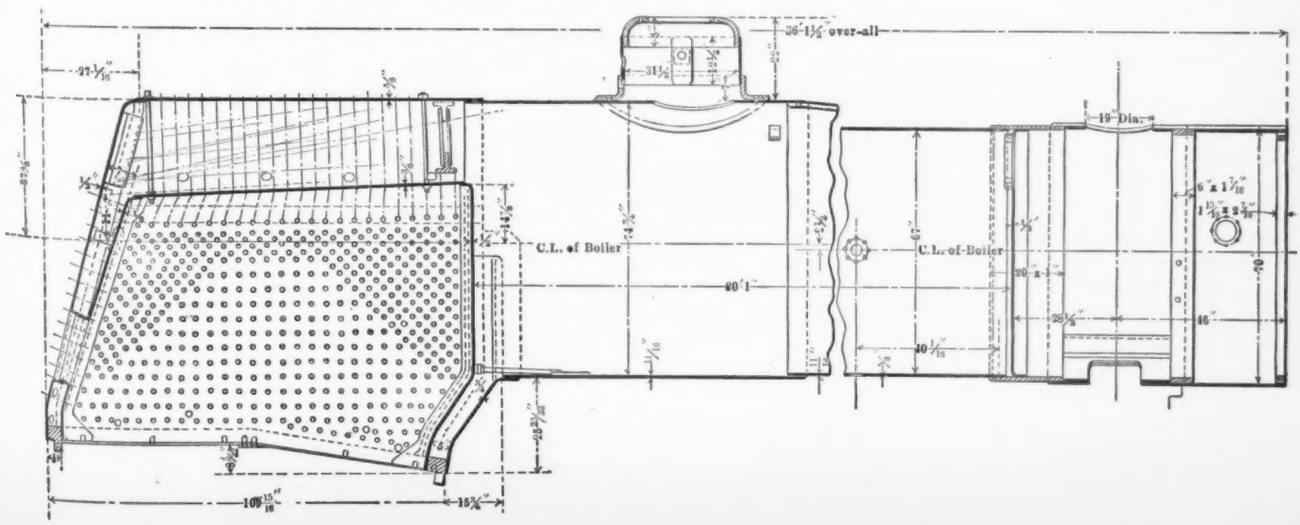
These locomotives are designed for a passenger run over the mountains from Roanoke, Va., to Bristol, Tenn. This train had previously been hauled by 10-wheel locomotives with 20 by 28-in. cylinders and 68-in. wheels, and with a somewhat greater weight on drivers than was given to the newer engines, but necessarily with a considerably smaller boiler. As far as tractive power was concerned the 10-wheel engines were satisfactory, but it was found that the boiler was not capable of supplying the cylinders under the difficult operating conditions met with. These new engines have been in service long enough to show that even with less weight on drivers they are capable of handling the train, even with extra cars, to much better advantage than the older engines, being able to make up considerable time on a difficult schedule.

As may be seen by reference to the table of dimensions these locomotives have 20 by 28-in. simple cylinders and 68-in. drivers, giving a tractive power of 28,000 lbs. The weight on drivers is 125,000 lbs., or 64 per cent. of the total weight of 195,250 lbs. The tractive ratio of 4.46 is within the limits of good adhesion.

The boiler, sections of which are given herewith, is 67 ins. in diameter at the front ring and 74¾ ins. at the dome course. It is of the extended wagon top type and contains 279—2¼-in. flues 20 ft. 1 in. long. The smokebox, which extends 46 ins. ahead of the centre of the cylinders, is connected to the boiler by a ring 20 ins. wide by 1 in. thick. The forward barrel sheet is fastened to the inside of this ring at one end and the smokebox to the outside of it at the other. The front tube sheet is fastened inside the ring just ahead of the connection to the boiler shell. This construction, while somewhat

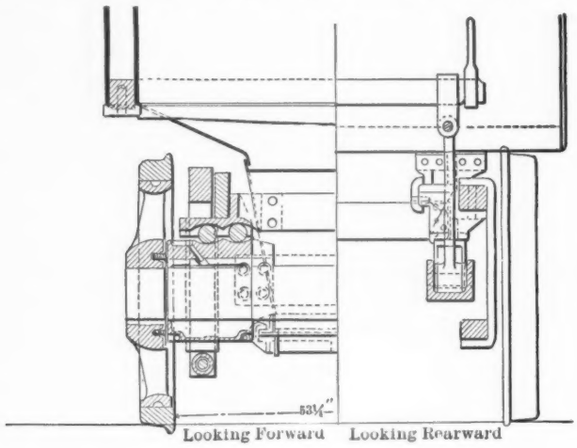


HALF CROSS-SECTION AND END VIEW.



LONGITUDINAL SECTION OF BOILER—PACIFIC TYPE LOCOMOTIVE—NORFOLK & WESTERN RAILWAY.

unusual, has a number of points in its favor when considered with a view to boiler repairs. The firebox measures 64¼ by 100 ins. and gives a grate area of 45.5 sq. ft. The front mud ring is 5 ins. wide and the water space in the throat is about the same width all the way up. The outside and inside firebox sheets are vertical, extending up from the 4½-in. mud ring to the crown sheet without perceptible increase of water space.



SECTION NEAR TRAILER TRUCK—PACIFIC TYPE LOCOMOTIVE NORFOLK & WESTERN.

At the rear, however, the mud ring is 4 ins. wide and the water space is increased to 7 ins. at the crown sheet. The crown sheet has a slope of nearly 4 ins. toward the rear. It will be noticed that an unusually large number of staybolts have been placed along the top and upper corners of the side sheets. Former trouble with staybolt breakages led to the decision to double the number of bolts at the points where the most trouble occurred.

This boiler gives a total heating surface of 3,463.7, of which 3,286.2 sq. ft. is in the tubes and 177.5 in the firebox. This amount of heating surface is unusually large for an engine having cylinders of this size and gives 340 sq. ft. of surface per cubic foot of cylinder volume, a figure considerably in excess of most simple passenger locomotives, but one which has proven itself to be most useful in service. The B. D. ratio (tractive effort × diameter of drivers ÷ heating surface) of 550 also indicates very clearly that these engines have an ample boiler capacity for high speed work; however, in this consideration it should be remembered that a very large proportion of this heating surface is in the flues, there being less than 5¼ per cent. of the total in the firebox, the remainder being in flues of a length equal to 107 diameters.

The trailing truck construction here employed is of interest. The frames are continuous and hence inside the trailing wheels. The trailing journal boxes are of special design and extend some distance inside of the frames, and have two slight depressions with chilled surfaces on the top in which rest two steel rollers. On top of the rollers is a casting having similar depressions for bearing surfaces, and above this, just inside the frame, is an equalizer which fastens through links to one end of an elliptical spring at the rear and to an equalizing bar in front. The upper bearing plates are connected together across the engine, thus being held stationary in the horizontal plane. The equalizing bar connecting the spring from the rear drivers and the equalizer over the trailing truck is necessarily inside the plane of the frame and is U shape in section. Its centre bearing is taken through a semi-elliptical spring which rests upon a frame-stiffening casting extending between the frames. This casting also forms the firebox support at this point. This construction, together with the connections and the spring rigging to the rear drivers, is shown in one of the illustrations herewith.

The front truck is of the three-point suspension type and will be illustrated separately in a later number. The general dimensions, weights and ratios are as follows:

SIMPLE PACIFIC TYPE PASSENGER LOCOMOTIVE, NORFOLK & WESTERN RAILWAY.

GENERAL DATA.

Gauge	4 ft. 8½ ins.
Service	Passenger
Fuel	Bit. Coal
Tractive power	28,000 lbs.
Weight in working order	195,250 lbs.
Weight on drivers	125,000 lbs.
Weight of engine and tender in working order	305,150 lbs.
Wheel base, driving	12 ft.
Wheel base, total	30 ft. 6½ in.
Wheel base, engine and tender	54 ft. 11 15-16 ins.

RATIOS.

Weight on drivers ÷ tractive effort	4.46
Total weight ÷ tractive effort	6.98
Tractive effort x diam. drivers ÷ heating surface	550
Total heating surface ÷ grate area	76.
Tube heating surface ÷ firebox heating surface	18.5
Weight on drivers ÷ total heating surface	36.2
Total weight ÷ total heating surface	56.3
Volume both cylinders	10.2 cu. ft.
Total heating surface ÷ vol. cylinders	340
Grate area ÷ vol. cylinders	4.47

CYLINDERS.

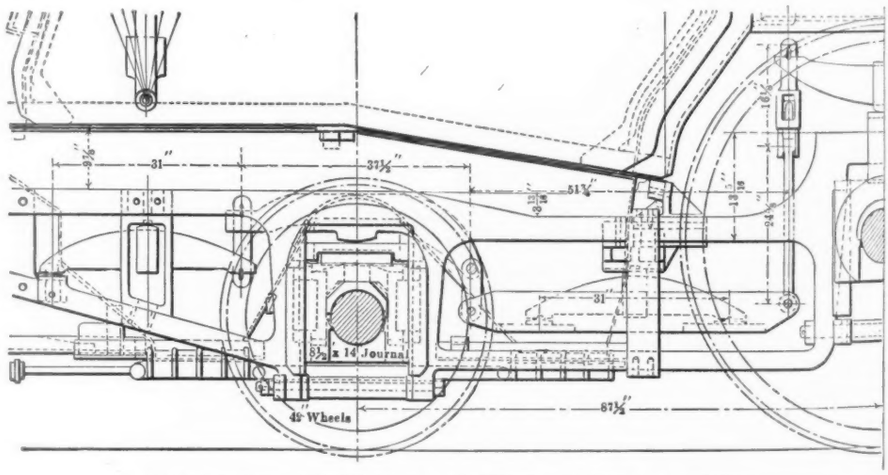
Kind	Simple
Diameter and stroke	20 x 28 ins.

VALVES.

Kind	Piston
Greatest travel	6¼ ins.
Outside lap	1⅛ ins.
Inside clearance	0 in.

WHEELS.

Driving, diameter over tires	68 ins.
Driving, thickness of tires	3 ins.
Driving journals, main, diameter and length	8½ x 10½ ins.
Driving journals, others, diameter and length	8½ x 10½ ins.
Engine truck wheels, diameter	33 ins.



TRAILER TRUCK—PACIFIC TYPE LOCOMOTIVE—NORFOLK & WESTERN

Engine truck, journals	5½ x 10 ins.
Trailing truck wheels, diameter	42 ins.
Trailing truck, journals	8½ x 14 ins.

BOILER.

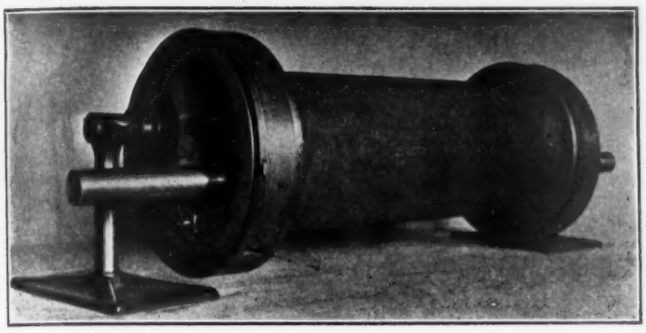
Style	Ext. Wagon Top
Working pressure	200 lbs.
Outside diameter of first ring	67 ins.
Firebox, length and width	99 15-16 x 64¼ ins.
Firebox, plates, thickness	⅜ & ½ in.
Firebox, water space	4-4½-5 ins.
Tubes, number and outside diameter	279-2¼ in.
Tubes, length	20 ft. 1 in.
Heating surface, tubes	3286.2 sq. ft.
Heating surface, firebox	177.5 sq. ft.
Heating surface, total	3463.7 sq. ft.
Grate area	45.5 sq. ft.
Smokestack, diameter	15 ins.
Smokestack, height above rail	15 ft. 3⅜ ins.

TENDER.

Tank	"U" shape.
Frame	Channels
Wheels, diameter	33 ins.
Journals, diameter and length	5¼ x 9 ins.
Water capacity	6,000 gals.
Coal capacity	10 tons.

A SUCCESSFUL PISTON VALVE.

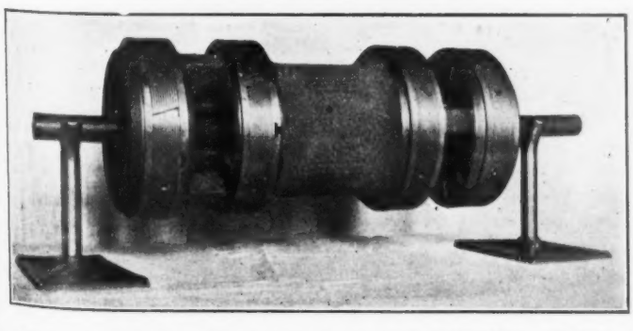
The following data which we have received concerning tests of the American Semi-plug piston valve speaks for itself. In June, 1901, Mr. C. R. Williams, general master mechanic of the Buffalo & Susquehanna Railroad Company, equipped a consolidation locomotive with these valves. After being in service for two years and ten months, during which time the engine ran 91,341 miles, the valves were removed for exhibition at the Louisiana Purchase Exposition, and were found to be in good condition with the cages or bushings worn perfectly true.



SEMI-PLUG PISTON VALVE AFTER RUNNING OVER STEAM PORTS WITHOUT BRIDGES ONE YEAR ON N. Y. C. & H. R. R. R.

It was found impossible to remove the bushings without destroying them, and they were equipped with a new set of valves. During July of this year, or five years after the bushings had been placed in service, the engine was placed in the shop for repairs and the bushings were found to be still steam tight, and to all appearances the same as when first applied. This is indeed a remarkable result, especially in view of the fact that the profile of the division upon which the engine was operated is such as to necessitate a considerable amount of drifting. No relief or by-pass valves were used in connection with the piston valves, and the engine when drifting was operated the same as if equipped with slide valves.

An examination of the construction and operation of the valves shows why these remarkable results were obtained. The inner sides of the snap-ring, shown in the illustration of the valve, are beveled, while the outer sides fit against the straight walls of the spool. The wall rings are solid and non-expansible and the inner sides are beveled to a much sharper angle than the outer sides, which are in contact with the snap-rings. The snap wedge ring between the two wall rings is put in under tension, thus holding the wall rings apart and applying a slight lateral pressure on the snap-rings. In this condition the snap-rings are expanded against the casing, just enough to make a steam tight joint. When steam is admitted to the valve it enters underneath the wedge ring, forcing it outward, and thus exerting a greater lateral pressure on the snap-rings and locking them in position. The function of the wide ring, which is between the snap rings and interlocked with them, is to keep them parallel when the wedge ring is collapsed, as in drifting. It also compels the snap-rings to expand and contract together, thus supplying a means of passing over the steam ports when the engine is drifting without allowing the snap-rings to spring into the ports.

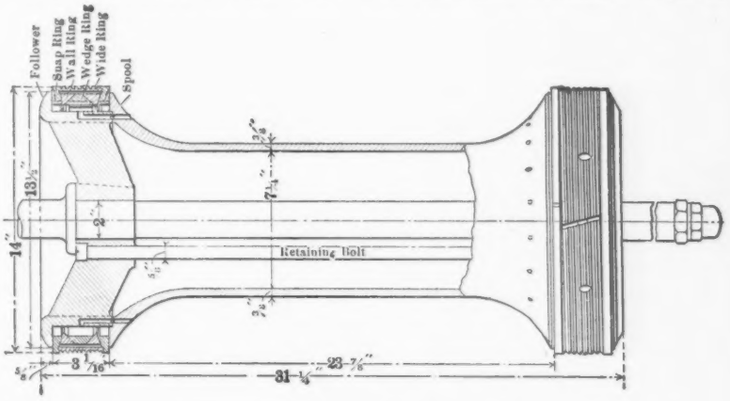


DOUBLE END SEMI-PLUG PISTON VALVE FOR COMPOUND ENGINE.

The valve is thus in effect a plug valve with an automatic adjusting snap-ring operating with a minimum amount of friction. This latter feature is important when we consider that the ordinary type of piston valve is unbalanced, and a considerable amount of power is required to overcome the excessive friction caused by the pressure of the rings against the walls of the valve chamber.

To demonstrate that the contact of the rings with the bushing is absolutely controlled, a set of valves were applied to an engine on the Pennsylvania Division of the New York Central & Hudson River Railroad under Mr. E. A. Walton, division superintendent of motive power, on July 1, 1905. The bridges in the steam ports were removed. After a year's service, with the valves passing over the ports without bridges, there was no sign of a blow and no perceptible wear of either the valve bushings or rings.

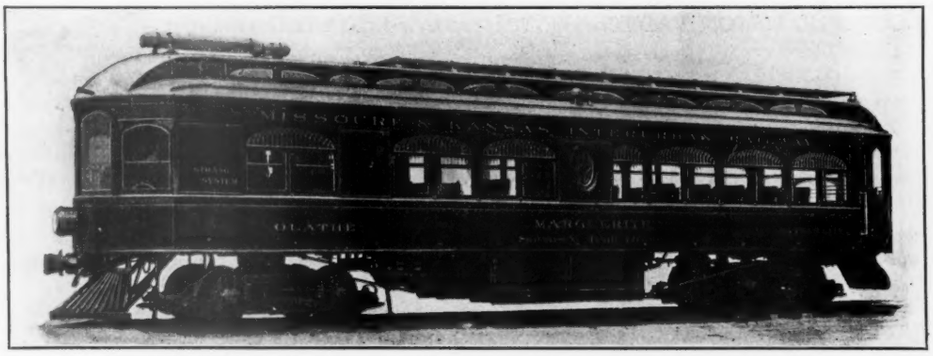
The committee on piston valves in their report to the Master Mechanics' Association in 1904 cited a number of careful tests which were made by the Norfolk & Western Railway and the Lake Shore & Michigan Southern Railway to determine the amount of leakage of valves. The best piston valve showed a leakage of 268.56 lbs. per hour and the best slide valve a leakage of 348 lbs. per hour. The worst case of leakage of piston valves amounted to 2,880 lbs. per hour and of slide valves to 2,610 lbs. per hour.



SEMI-PLUG PISTON VALVE.

The leakage of the Semi-plug piston valve, as indicated by the service results, is very slight, if any, and this considerable saving in addition to the saving of power, due to its being perfectly balanced, should materially aid in increasing the capacity of our motive power, which as far as size and weight are concerned, has apparently about reached the limit for operation under existing conditions. These valves, manufactured by the American Balance Valve Co., Jersey Shore, Pa., in addition to being made with the single end for simple engines, are also made with double and triple ends for compound engines.

NEW PENNSYLVANIA STEEL COACH.—The Pennsylvania Railroad has designed and built at Altoona a steel coach which weighs 103,550 lbs., as compared to 84,900 lbs. for the standard wooden coach. The extra weight is to some extent caused by the storage batteries for electric lighting and the heavy fireproof floor. The car has been placed on a local run and is being carefully tested. It is understood that the Pennsylvania intends to build a large number of steel cars for use in the New York tunnel, and that it has also requested the Pullman Company to make designs for sleeping cars of steel construction to be used on the Pennsylvania Lines.



STRANG GASOLINE-ELECTRIC MOTOR CAR—SANTA FE TRAIL ROUTE.

THE STRANG GASOLINE ELECTRIC MOTOR CAR.

The Strang gasoline electric motor car, "Ogerita," described on page 103 of our March issue, was placed in service in April on the Missouri & Kansas Interurban Railway, which is known as the Santa Fe Trail Route, and runs between Kansas City and Olathe, Kan., a distance of 22 miles. At the present time the car is being operated between Kansas City and Lenexa, a distance of 15 miles. It is making four round trips daily, hauling one or two trail cars, and has never missed a trip from any cause whatever since being placed in regular service. In order to hasten the completion of the line, the "Ogerita" was used as a freight engine, in some cases hauling as many as six freight cars from the main line of the Frisco Railroad to the tracks of the Santa Fe Trail Route.

Two new cars, the "Marguerite" and "Geraldine," equipped with the Strang system, have just been built for the Santa Fe Trail Route by the J. G. Brill Company, of Philadelphia. The "Marguerite," a combination passenger and smoker, shown in the illustration, measures 52 ft. 9 ins. over the ends, and the length of the passenger, smoking and engine compartments is respectively 27 ft. 5 ins., 10 ft. 8 ins., and 14 ft. 8 ins. The engine is a 4-cylinder, vertical type with 10 by 10-in. cylinders and, being equipped with an automatic regulating apparatus, requires no attention while running.

The first car, the "Ogerita," has traveled 18,000 miles, and the only repairs necessary have been those due to the renewing of brake shoes, etc. This car went from Philadelphia to Kansas City in February over the Pennsylvania, West Shore, Lake Shore, Alton, and Rock Island Railroads, stopping at the principal points for inspection by railway officials. The average speed for the greater part of this distance was about forty-five miles an hour. Snow storms and the necessity at times of running behind freight trains reduced the average speed for the entire distance to about thirty-three miles per hour. The trip was made without any mishaps, and the engine was in first-class condition upon arrival at Kansas City. A trip was then made over the Santa Fe from Kansas City to Topeka and return. A heavy snow storm, with heavy drifts, was encountered on the return trip, but the car made the trip on schedule time, although regular trains were delayed by the storm. The Santa Fe officials then arranged a trip through southern Kansas from Kansas City to Independence and over a branch line of that system known as the Burlington branch. The round trip of 550 miles was made at an average speed of forty miles per hour. The Burlington Branch has grades as high as 3½ per cent. and curves as sharp as 16 degs. No difficulty was found in stopping and starting the car on a 3½ per cent. grade, and the average speed on the round trip of 118 miles over this branch was twenty-seven miles per hour.

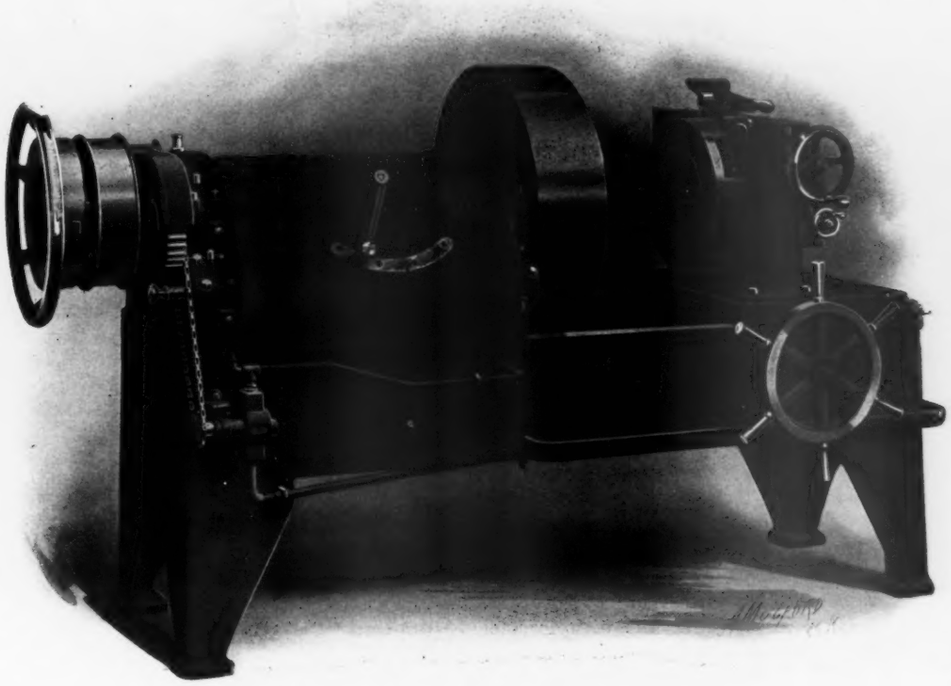
The total number of passengers carried in the New York Subway during April, May and June of this year was 37,161,607, as compared to 26,942,295 for the previous year. The car mileage was 8,656,535, as compared to 7,695,122.

CAST IRON CAR WHEELS SHOULD BE MORE ELASTIC.—That the cast iron car wheel can be made stronger and more durable by making it more elastic is a theory that is gaining ground. The present form of double plate wheel is extremely rigid, and contains metal where it is least needed. By reducing the rigidity of the portion between the rim and the hub the wheel will be made more flexible and better able to withstand shocks. In this way the flange, which is now the weakest part, and which cannot be enlarged because of the limitations imposed by frogs and crossings, will be relatively strengthened.—*The Iron Age.*

THE TURBINE STEAMSHIP LUSITANIA.—The largest horsepower afloat up to the present does not much exceed half that of the "Lusitania," which latter, at a minimum, will be 65,000. Since the ship has four separate propellers, each of these will have to absorb, say 16,500 h.p. The steam consumption of the "Lusitania" turbines may probably be taken fairly at 15 lbs. per h.p. per hour. This gives for 65,000 h.p. no less than 435 tons of steam per hour, and probably not much less than 50 tons of coal in the same period, or, say 1,200 tons per day of 24 hours. It is not remarkable that the engine and boiler room crews number 400 men.—*Cassier's Magazine.*

PROPER SALARY FOR PROPER MEN.—In this connection I would suggest that one of the best factors to improve and strengthen the position of engine house or terminal foreman is to give it the recognition and standing that it requires, on account of its importance in the mechanical department, and its far-reaching effects to other departments; that the salary paid this class of service be sufficiently high and remunerative to attract and obtain the proper class of men, who are competent and fitted to care for the work successfully and give it the proper kind of supervision, to obtain the best results expeditiously and economically, and take care of the various duties which come up every day, in such a way that the service is benefited and improved.—*Mr. E. T. James, New York Railroad Club.*

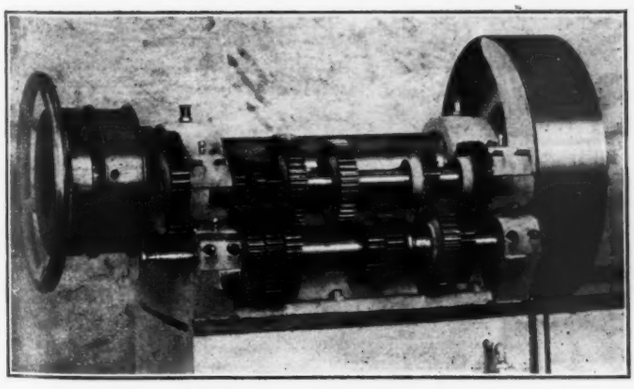
AN EXPOSITION OF SAFETY DEVICES.—The American Institute of Social Service will hold in New York City, in January next, an exposition of devices for safeguarding the lives and limbs of working men and women, and for preventing accidents under the ordinary conditions of life and labor to which the general public is exposed. The interest of manufacturers generally is solicited, as well as that of organizations whose special function is to improve the conditions of labor, and a widespread response is looked for to this request for representation in the nature of photographs, descriptive drawings, models, and, as far as possible, the devices themselves in actual operation. Requests for information regarding space should be made to Dr. William H. Tolman, Director, 287 Fourth Avenue, New York.



FOUR-INCH PIPE MACHINE—STOEVER FOUNDRY & MFG. COMPANY.

FOUR-INCH PIPE MACHINE.

The 4-in. pipe machine, illustrated herewith, is of very substantial construction, carefully designed to withstand the most severe strains, and may be quickly and conveniently operated It has a capacity for from 1 to 4-in. pipe. The head stock is made in one casting. Twelve spindle speeds are obtained by means of the gear box. Four changes of speed are furnished by the handle on the side of the box, which throws different sets of gears into mesh, and three runs of gearing are obtained by means of a sliding key operated by the handle or knob at the left of the gear box. The gears are protected by guards. A speed plate on the gear box, conveniently placed for the operator, indicates how to obtain the proper speed for different sizes of pipe. The reverse movement for cutting left-hand threads may be obtained by means of a crossed belt on the countershaft. If desired, a motor drive may be used, a 1½-h.p. constant-speed motor being placed above the head stock and connected to the driving shaft by Morse silent chain. A variable speed motor is not required, as sufficient speeds are provided by the gear box.



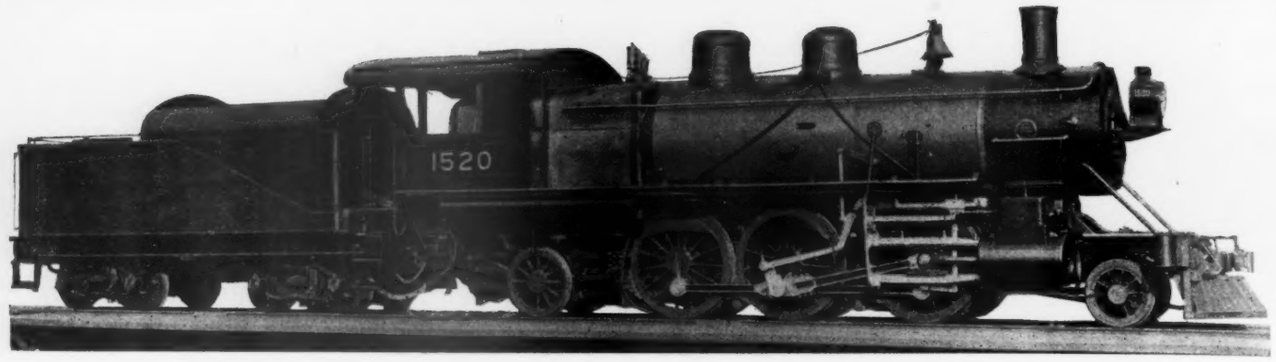
ARRANGEMENT OF GEARING ON PIPE MACHINE.

The gripping chuck is universal and grips the pipe at three points. The chuck may be operated from any one of three points on the circumference by a socket wrench. A centering chuck is placed on the rear of the spindle. It is a scroll chuck with three jaws and is easily operated by the large hand wheel on the outside of the shell.

The adjustable mechanism for setting the chasers is very simple. As the lever which operates it comes to rest on the screw, the straight-line feature is secured, and no digging into the pipe before releasing is possible. The cams are of steel, hardened and inserted in the cam ring. They are interchangeable and, if necessary, may be replaced at a small cost. In the die head the bottoms of the slots in which the chasers travel are formed of hardened steel plates, which keep the lead of the chasers true. The chasers are made of single pieces of steel, without links or pins. They are made one at a time by a special process, and any single chaser in the set may be replaced. They are inserted and removed through the center of the head. Oil is delivered to the dies and cutting-off tool by a pump driven by a chain, as shown. The pump operates with the machine running in either direction. The weight of this machine, which is made by the Stoever Foundry & Manufacturing Company of Myerstown, Pa., is 2,800 lbs.

COMPARATIVE TESTS OF ALCOHOL AND GASOLINE.—Tests recently made in internal combustion engines indicate a very high operating economy from alcohol, though it has only about 70 per cent. of the thermal value of gasoline. The superior economy with alcohol, which has been put as high as 20 per cent., is due in part to the higher pre-ignition compression. This showing is of considerable importance, in view of the removal next year of the internal revenue tax on denatured alcohol, which will, it is said, permit the commercial product to be sold for about the present price of gasoline. It is generally considered that alcohol may be used in standard gasoline engines with some slight modifications in the carbureter or vaporizing devices.—*Engineering Record.*

BRIQUETTES AS LOCOMOTIVE FUEL.—Consul James C. McNally, writing from Leige, says that it is interesting to note the continued increase in the use of briquettes which were introduced on the Belgian State Railways in 1898. For that year the consumption was 208 tons; in 1899, 3,900 tons; 1900, 20,472 tons; 1901, 67,775 tons; 1902, 110,600 tons; 1903, 152,219 tons, and in 1904, 205,175 tons.—*Ideal Power.*



PRAIRIE TYPE LOCOMOTIVE, WITH WALSCHAERT VALVE GEAR—GREAT NORTHERN RAILWAY.

SIMPLE PRAIRIE TYPE LOCOMOTIVE WITH WALSCHAERT VALVE GEAR.

GREAT NORTHERN RAILWAY.

The Baldwin Locomotive Works has recently delivered an order of 50 Prairie type locomotives to the Great Northern Railway, which are illustrated herewith. These engines are, as regards size and capacity, almost identical with locomotives of similar type in use on the Chicago, Burlington & Quincy Railway, which were illustrated in the AMERICAN ENGINEER AND RAILROAD JOURNAL, September, 1904, page 356. The Great Northern engines, however, have cylinders 22 by 30, or 2 ins. longer than those used on the Burlington, which gives them a larger tractive force. They also have balanced slide valves and Walschaert valve gear instead of piston valves with Stephenson valve gear. Another difference noticeable in the two designs is the fact that the trailing wheels have inside bearings and that a Belpaire firebox has been used on the Great Northern engines.

A design of Walschaert valve gear is used on these engines which has been given careful study to make it as simple and convenient for repairs as possible. It will be seen, by reference to the illustrations, that the link is carried on a trunnion, which rests in bearings fastened to the back of the guide yoke, and receives its motion from the eccentric rod through an arm on the outer end of the trunnion. The whole gear has been thrown inward to an extent which permits the combination lever to extend down inside the guides, and thus throws the center of the valve 3 ins. inside the center of the cylinder. The details of this gear are clearly shown in the illustration.

Other interesting features in this engine are the use of a very short balanced slide valve set high above the cylinder, thus giving long steam ports; the location of the headlight on the front end door and the placing of the injectors on the back head and connecting them through external pipes to check valves at the usual location. The general dimensions, weights and ratios are as follows:

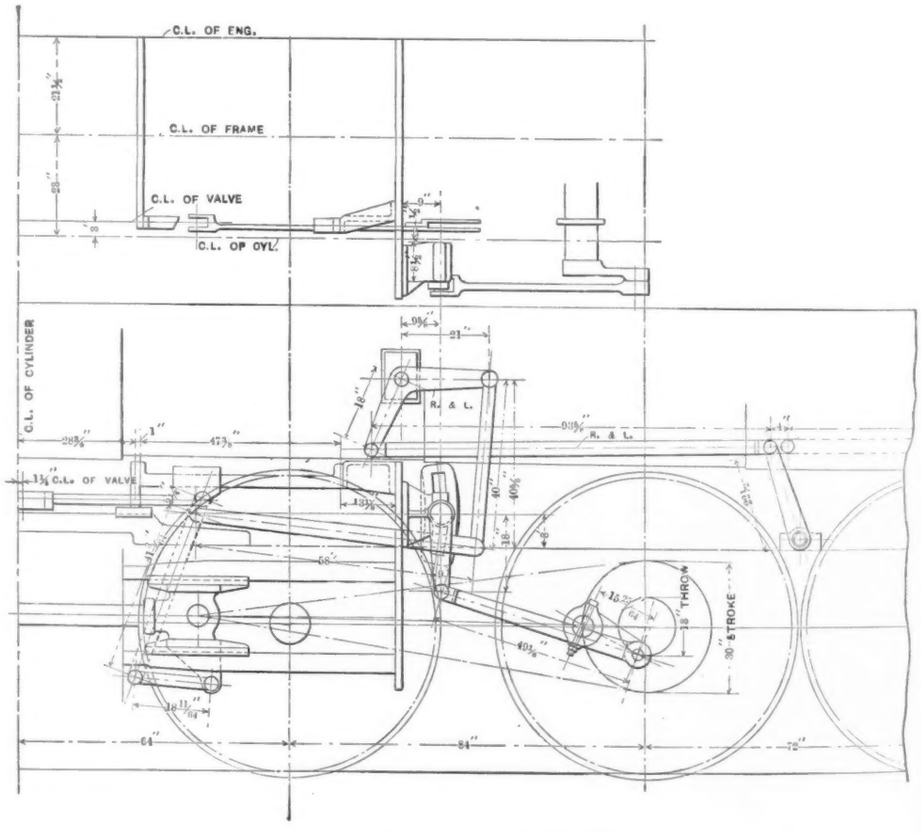
SIMPLE PRAIRIE TYPE FREIGHT LOCOMOTIVE—GREAT NORTHERN RAILWAY.

GENERAL DATA.

Gauge	4 ft. 8½ ins.
Service	Freight
Fuel	Bit. coal
Tractive power	37,560 lbs.
Weight in working order, est.	209,000 lbs.
Weight on drivers, est.	151,000 lbs.
Weight on leading truck, est.	21,000 lbs.
Weight on trailing truck, est.	37,000 lbs.
Weight of engine and tender in working order, est.	360,000 lbs.
Wheel base, driving	13 ft.
Wheel base, total	30 ft. 9ins.
Wheel base, engine and tender	63 ft. 8 ins.

RATIOS.

Weight on drivers ÷ tractive effort	4.02
Total weight ÷ tractive effort	5.56
Tractive effort x diam. drivers ÷ heating surface	746



APPLICATION OF WALSCHAERT VALVE GEAR.

Total heating surface ÷ grate area	65
Firebox heating surface ÷ tube heating surface	63.90
Weight on drivers ÷ total heating surface	43.5
Total weight ÷ total heating surface	60
Volume both cylinders	13.2 cu. ft.
Total heating surface ÷ vol. cylinders	263
Grate area ÷ vol. cylinders	4.04

CYLINDERS.

Kind	Simple.
Diameter and stroke	22 x 30
Valves	Bal. Slide

WHEELS.	
Driving, diameter over tires	69 ins.
Driving, thickness of tires	3½ ins.
Driving journals, main, diameter and length	9½ x 12 ins.
Engine truck wheels, diameter	36 ins.
Engine truck, journals	6 x 12 ins.
Trailing truck wheels, diameter	45 ins.
Trailing truck, journals	8 x 12 ins.
BOILER.	
Style	Belpaire
Working pressure	210 lbs.
Outside diameter of first ring	72 ins.
Firebox, length and width	116 x 66 ins.
Firebox plates, thickness	⅜ & ½ in.
Firebox, water space	5 ins.
Tubes, number and outside diameter	301-2¼ in.
Tubes, length	18 ft. 6 in.
Heating surface, tubes	3,265 sq. ft.
Heating surface, firebox	206 sq ft.
Heating surface, total	3,471 sq. ft.
Grate area	53.4 sq. ft.
TENDER.	
Water capacity	8,000 gals.
Coal capacity	12 tons.

COMPARATIVE TEST OF SIMPLE AND COMPOUND LOCOMOTIVES.

The general results of a series of tests on two 10-wheel freight locomotives, one a simple and one a four-cylinder Vauclain compound engine, were given in a paper presented at the April meeting of the Western Railway Club by Mr. J. F. De Voy, mechanical engineer, Chicago, Milwaukee & St. Paul Railway.

	Simple.			Compound.		
Number of run	1	2	3	1	2	3
Tonnage	982	1,140	1,152	1,074	1,106	1,050
Speed M. P. H.	28.2	23.56	29.1	26.5	20	28.5
Average draw bar pull	11,400	10,720	7,640	9,730	11,860	10,000
Average D. H. P.	972	711.8	633	702	675	821
Average I. H. P.	1,068	779	775	813	753	902
B. T. U. per D. H. P. Hour	46,554	52,861	65,002	51,933	47,578	47,511
Dry coal per sq. ft. grate per hr. lbs.	108.1	89.7	99.2	85	75	91
Water evaporated from 212° per sq. ft. H. S. per hr. lbs.	8.14	7.08	7.16	7.15	6.36	7.38
Water evaporated from 212° per lb. dry coal fired	6.02	6.44	5.84	6.75	6.76	6.49
Boiler efficiency	50.6%	53.1%	48.4%	55.7%	56.1%	54.1%
Steam per I. H. P. per hr. lbs.	21.43	25.7	26	24	23.5	22.92
Engine efficiency	9.975%	8.825%	7.75%	9.17%	10.3%	9.73%
Locomotive efficiency	4.8%	4.27%	3.64%	4.74%	5.04%	4.96%

The two locomotives had the following general dimensions:

	Simple.	Compound.
Weight on drivers	141,080 lbs.	135,555 lbs.
Cylinder diam. and stroke	21 x 30 ins.	15 & 25 x 30 ins.
Diameter of drivers	69 ins.	68 ins.
Steam pressure	200 lbs.	200 lbs.
Tube heating surface	2,748 sq. ft.	2,748 sq. ft.
Firebox heating surface	218 sq. ft.	198 sq. ft.
Total heating surface	2,966 sq. ft.	2,946 sq. ft.
Grate area	34.16 sq ft.	35 sq. ft.

Three regular test runs besides a preliminary run were made on each engine over a 125-mile division, with loads and results as shown in the above table.

In commenting on the results Mr. De Voy says: "The dry steam per dynamometer horse power is shown to be slightly less for the compound, with the exception of run No. 1 of simple engine. This is explained by the fact that on this run the engine was the more economically loaded than any of the other test runs. On this run the engine efficiency as well as the boiler and engine efficiency was very high, although not as high as the average compound efficiency.

"It appears from the results found that the compound gives a higher evaporation than that of the simple. The relative efficiency over that of the simple being about 5.8 per cent.

"On these runs where the speed maintained was highest and the dynamometer horse power least, due obviously to an underloaded train, the economy of the engines is the smallest. Thus on run No. 3 of simple engine the speed maintained was higher and the average draw bar pull lower than for any other run. The B. T. U. per dynamometer horse power per hour is 25 per cent. greater than for any other run of either engine. This shows that on this run the engine was greatly underloaded and was running very uneconomically.

"It goes to show by an examination of the various runs of both engines, that when a locomotive attains a high rate of speed, a comparative small addition of load does not affect the coal consumption proportionately. This is shown particularly by glancing at the average draw bar pull and speed maintained by the simple engine on her first run, and the very uneconomical results obtained by the same engine on her third run.

"Run No. 1 of the compound also presents this feature of an uneconomical load.

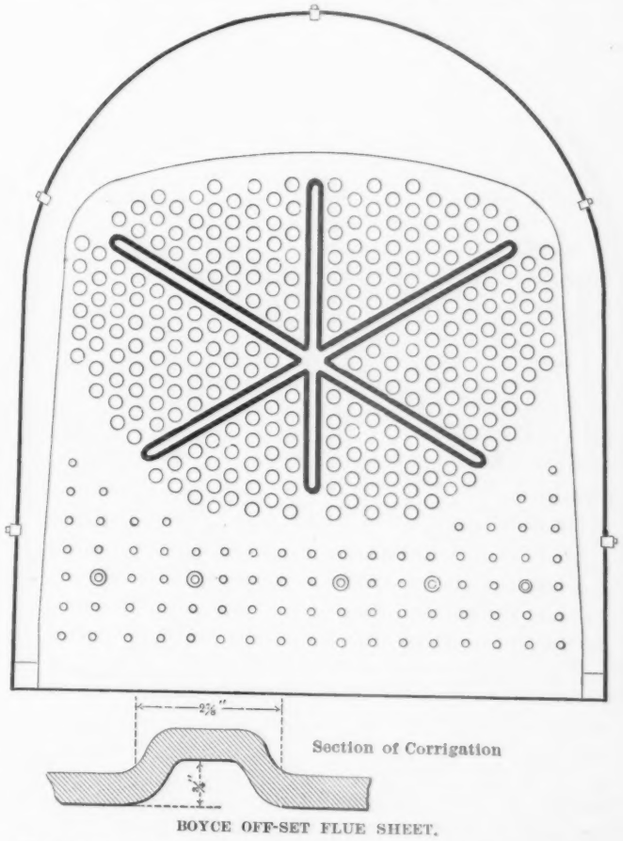
"If we consider all the runs of each engine, the saving of fuel in favor of the compound is 11 per cent. But we think it but fair in the final comparison to throw out those runs where the engines were greatly underloaded.

"Doing this and throwing out run No. 3 of simple engine and run No. 1 of compound engine, we get as a final and correct comparison a saving of 4.35 per cent. of B. T. U. per dynamometer horse power per hour in favor of the compound.'

THE BOYCE OFF-SET FLUE SHEET.

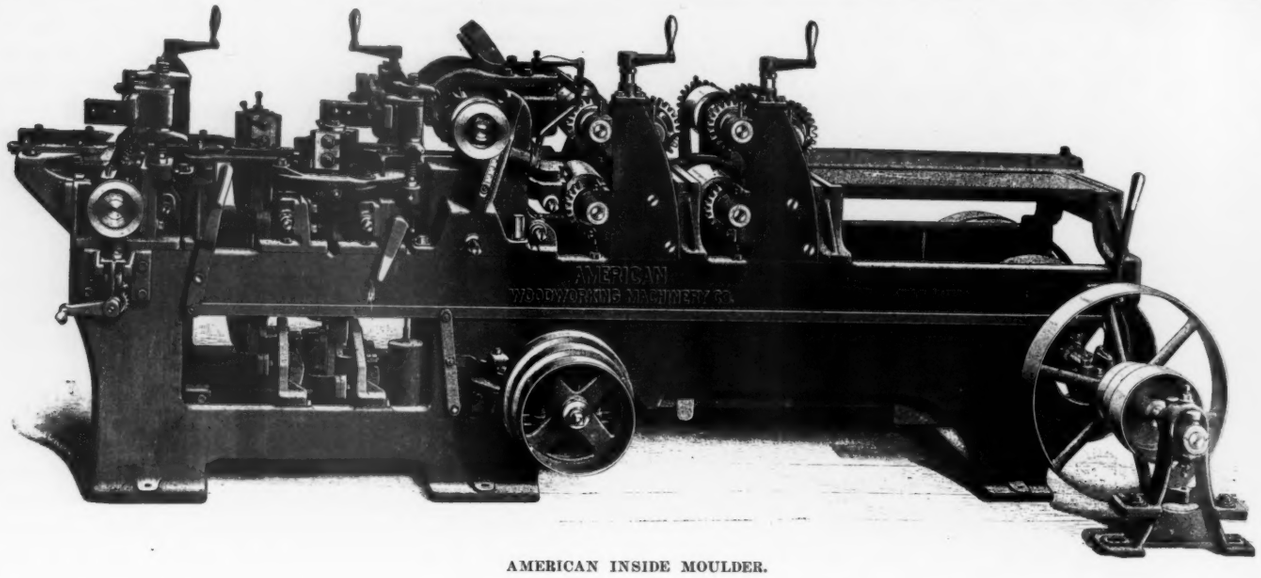
The accompanying illustration shows a firebox flue sheet which has been stiffened by means of corrugations pressed into the sheet. These corrugations are about 2⅞ ins. wide and ¾ of an inch deep and radiate from the centre in six directions to the edge of the section of the sheet covered by the flue holes.

The object of this is to so stiffen the sheet that it will better hold its shape and thus prevent the tendency to work on the rear end of the flues and cause them to leak. The corrugations necessitate the omitting of flues in the rows, as shown, which will result in better circulation around the flues and also by the proper location of washout plugs makes it possible to more thoroughly cleanse the flue sheet; it will, however, somewhat reduce the flue heating surface.



BOYCE OFF-SET FLUE SHEET.

This sheet is the invention of Mr. John J. Boyce, boiler shop foreman at the Burnside shops of the Illinois Central Railroad, and is being handled by the Boyce Off-Setting Flue Sheet Company, Room 4, 12 Sherman Street, Chicago, Ill.



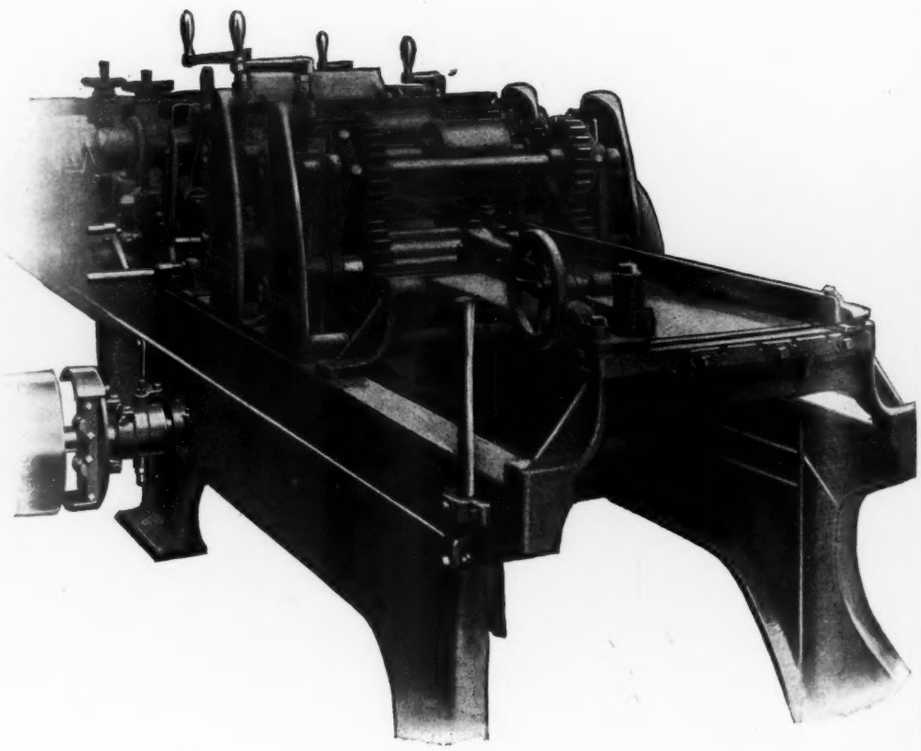
AMERICAN INSIDE MOULDER.

AMERICAN INSIDE MOULDER.

The American inside moulder, illustrated herewith, embodies all the late improvements, is strong and substantial, and has a capacity 12 and 14 ins. wide by 6 ins. thick. The long frame gives ample length of cylinder and side spindle belts, also good clearance around the cylinder and side heads. The feed is powerful, consisting of four large rolls, all geared on each end, weighted and fitted with a parallel lifting device, operated by one screw and having ball bearings. Springs are supplied to hold the stock to guide. The cylinders are of hammered crucible steel forgings. The bearings are of large diameter, running in self-oiling boxes. The boxes are connected by a yoke across machine, and the ends are securely clamped. The top cylinder is adjustable vertically by a crank and is clamped in position on both cylinder posts from the operating side of the machine. The screws and bevel gears for raising the top cylinder are housed within the cylinder posts, free from dirt and dust. The bottom cylinder moves laterally and has a parallel hoist. Both cylinders have a horizontal movement across the machine, to line to cut without disturbing the vertical adjustment of the heads.

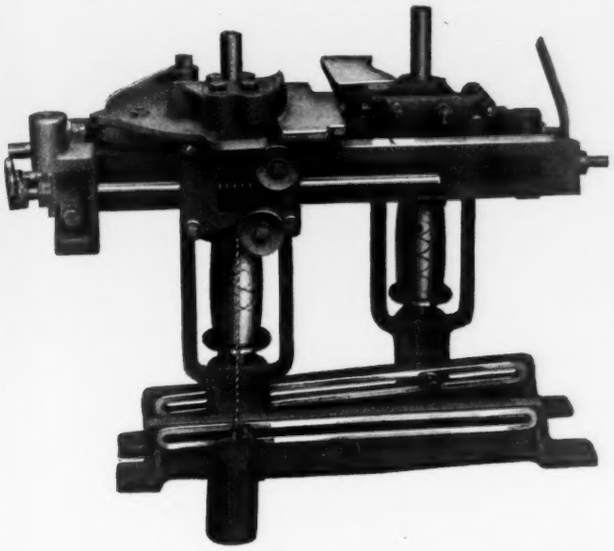
The plate under the top cutter head is slotted so that the cutters may be used to swing below the bed line to any depth of cut. It is bolted to the frame and may be easily removed, planed up and replaced. The chip breaker for the top head is adjustable to work as near the cutting edge of the knife as safety will permit and allow the knives to project so as to cut 3 ins. deep. The pressure bar and chip breaker for the lower head are adjustable for a 3-in. cut, the clamping bolts being on top and easy of access. The pressure bars after the cut of the top head, and over the lower head, are supported on both ends, adjustable quickly by screws on both ends, and swing up and back when required for setting up. The shoe holders on these bars are compound; that is, they take a shoe flat or on edge, as required.

The side spindles are large and run in self-oiling yoke boxes, tilt in either direction, are adjustable from both sides of the machine, and have a quick-acting wedge clamping device. The side heads are of hammered crucible steel forgings, with four sides, lipped and slotted, have the same swing and take the same knife and bolt as on the top and bottom cylinders. The side chip breakers are adjustable to admit of a 3-in. cut. The toe pieces that come in contact with the stock are removable and changeable.



SHOWING FEEDING-IN END OF MACHINE, METHOD OF EXPANSION GEARING AND EQUALIZING BAR FOR PARALLEL HOIST.

All short guides after the cut are adjustable across the machine, as well as to and from the cutters. The end of the bed swings down to admit of easy access to the bottom head, and the plate after the cut adjusts itself to any change of cut of the lower head. The plates that support the stock between the side heads are adjustable for any depth of cut, and the side yokes and bars which support them are also adjustable vertically to compensate for any wear. A friction cone feed



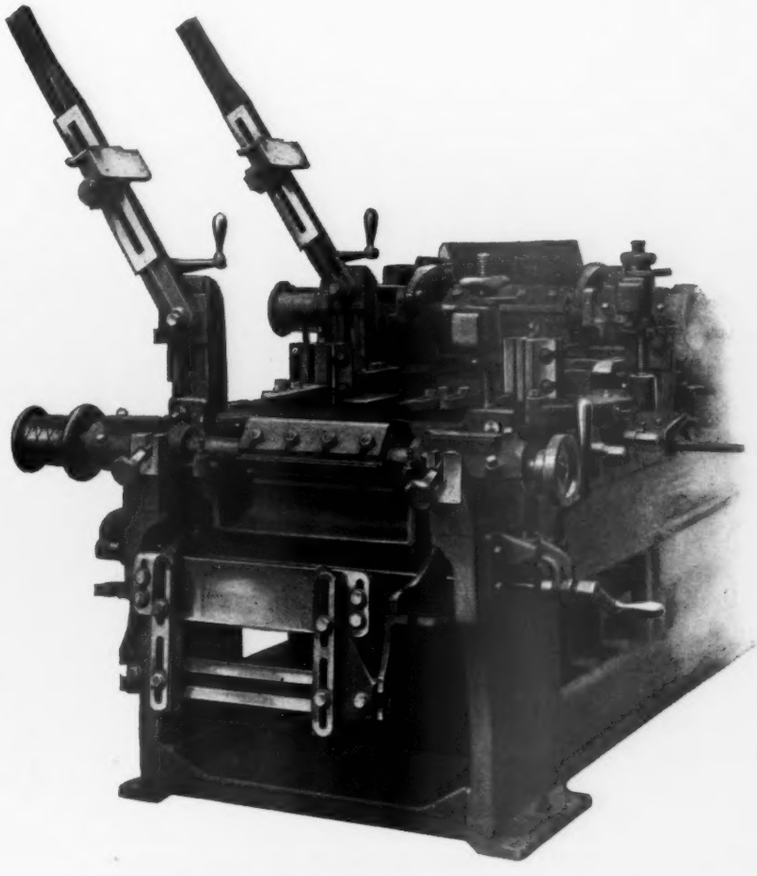
MATCHER STOCKS REMOVED FROM MACHINE, SHOWING GENERAL MANNER OF CONSTRUCTION AND METHOD OF LOCKING.

gives three changes of speed and is stopped and started from the feeding-in end, as well as at the side of the machine near the side heads. An extra cone, giving six changes, is furnished when ordered. The cutter head pulleys are pneumatic, carefully fitted to a true taper and held by a nut. These moulders are made by the American Wood Working Machinery Company.

THE BALANCED COMPOUND LOCOMOTIVE.—Locomotives have become too large to permit of continuing indefinitely the mere increase of size and weight. More scientific development is needed. The usual methods of counterbalancing answer very well for compartively light locomotives, but as locomotives become larger and the parts become heavier the internal stresses upon the engine itself, due to the inertia of the parts, and the effect upon the track of the unbalanced counter-weights, renders it necessary to devise a better scheme of balancing. In ordinary practice, counterweights are added to the driving wheels for the purpose of balancing the reciprocating parts, but the revolving weights themselves need balancing when near the top and bottom of their paths. When in these positions the counterbalance weights tend to change the weight on the driving wheels, due to the centrifugal action, acting vertically upward when the weights are near the top of their path, and acting vertically downward when they are near the bottom. The counterweights, therefore, tend to lift the locomotive in the one case, and tend to increase the weight on the rails in the other case. This causes the so-called "hammer blow" upon the rail, and because this so-called "hammer blow" sometimes amounts to 25 per cent. of the static weight on the rails, it becomes exceedingly important in limiting the weight allowed upon driving wheels. By using four cylinders and balancing reciprocating parts with other reciprocating parts, and revolving weights with revolving weights, a practically constant pressure on the rail is secured, which renders it permissible to increase the weight on the driving wheels without increasing the destructiveness upon the track. By this permissible increase of driving wheel load a larger boiler may be carried, which is greatly to be desired in locomotive practice to-day.

On the Pennsylvania testing plant at St. Louis the Cole four-cylinder balanced compound operated for a full hour at a speed of 75 miles per hour, thus indicating a remarkable capacity. Incidentally, economy of fuel and water constitute attributes of this type of locomotives, and in the constructive features it is found to be possible to materially lighten the parts because the work is divided among a larger number of them. The subdivision of the power reduces the fiber stresses on each of these parts, and the disturbing influences of very heavy rods and reciprocating parts are avoided. The effect of reciprocating parts upon the structure of the engine as the movements of these parts rapidly change in direction has probably never had the attention which its importance merits. For high-speed passenger service, and also for freight service, the four-cylinder balanced locomotive presents advantages which should be tested to the utmost.—*Mr. G. M. Basford, at Purdue University.*

STEEL RAILROAD TIES.—An order for 80,000 steel ties, or sufficient to lay thirty miles of track, was recently placed with the Carnegie Steel Company by the Bessemer Railroad of the United States Steel Corporation. The ties will be laid in continuous stretches instead of a number of short portions, as has been done by the various railroads that are experimenting with this type of tie.—*Engineering Record.*



SHOWING REAR TABLE DOWN AND ALL PRESSURE BARS UP, GIVING AMPLE ROOM FOR SETTING UP MACHINE.

PERSONALS.

Mr. J. J. Bartholomew has been appointed air brake inspector of the St. Louis-Southwestern.

Mr. H. A. Simms has been appointed general car inspector of the Illinois Central Railroad, succeeding Mr. R. C. Powell.

Mr. J. M. McMullin has been appointed master mechanic of the Lehigh Valley Railroad at Sayre, Pa.

Mr. Williard Kells, master mechanic of the Lehigh Valley at Sayre, Pa., has been transferred to Buffalo, N. Y.

Mr. Andrew M. McGill, a general foreman of the New York, New Haven & Hartford, has been appointed a master mechanic on the Lehigh Valley.

Mr. S. D. Kinney has resigned as superintendent of shops of the Gulf, Colorado & Santa Fe, at Cleburne, Tex., and the position has been abolished.

Mr. B. P. Meyers has been appointed master mechanic of the International & Great Northern, with headquarters at Taylor, Tex., to succeed Mr. C. M. McLain.

Mr. J. W. Cain has been appointed assistant engineer of tests of the Atchison, Topeka & Santa Fe, with office at Topeka, Kan.

Mr. T. E. Layden has been appointed assistant engineer of tests of the Atchison, Topeka & Santa Fe Coast Lines, with headquarters at San Bernadino, Cal.

Mr. T. P. Anderson has been appointed to the new office of superintendent of tests of the Cincinnati, New Orleans & Texas Pacific, with headquarters at Lexington, Ky.

Mr. O. M. Foster, general road foreman of engines of the Lake Shore & Michigan Southern, at Cleveland, Ohio, has been appointed assistant master mechanic at Elkhart, Ind.

Mr. M. J. McGraw, master mechanic of the Missouri Pacific at Fort Scott, Kan., has been appointed master mechanic at St. Louis, Mo.

Mr. W. C. Walsh, master mechanic of the Southern Indiana Railway, at Bedford, Ind., has been appointed master mechanic of the Missouri Pacific at Fort Scott, Kan.

Mr. L. Bartlett, master mechanic of the St. Louis Division of the Missouri Pacific, has retired after a service of 44 years with that road. He has been master mechanic for 21 years.

Mr. F. G. Grimshaw has been appointed assistant master mechanic of the Pennsylvania at Ormsby, Pa.

Mr. J. J. Walsh, master mechanic of the Pennsylvania Lines West of Pittsburgh, at Chicago, has been transferred to Logansport, Ind.

Mr. G. B. Fravel, master mechanic of the Pennsylvania Lines West of Pittsburgh, at Logansport, Ind., has been transferred to Dennison, Ohio.

Mr. P. F. Smith, Jr., master mechanic of the Pennsylvania Lines West of Pittsburgh, at Dennison, Ohio, has been transferred to Columbus, Ohio.

Mr. N. M. Loney, assistant engineer of motive power of the Pennsylvania Lines West of Pittsburgh, at Fort Wayne, Ind., has been appointed master mechanic at Chicago, Ill.

Mr. R. H. Smith, roundhouse foreman of the Great Northern Railroad at St. Paul, Minn., has been appointed master mechanic at Crookston, Minn.

Mr. W. W. Breckenridge, division master mechanic of the Great Northern Railway at Crookston, Minn., has been transferred to Great Falls, Mont.

Mr. F. M. Fryburg, division master mechanic of the Great Northern Railway at Great Falls, Mont., has been appointed general master mechanic of the Central District, with headquarters at Minot, N. D.

Mr. W. C. A. Henry, master mechanic of the Pennsylvania Lines West of Pittsburgh, at Columbus, Ohio, has been appointed assistant superintendent of motive power of the Southwest System, with headquarters at Columbus, Ohio.

Mr. R. D. Hawkins, general master mechanic of the Central District of the Great Northern Railway, has been appointed mechanical engineer, with headquarters at St. Paul, Minn., to succeed Mr. G. Willius, who has resigned to go into other business.

Mr. G. A. Gallagher, master mechanic of the Illinois Southern at Sparta, Ill., has been appointed master mechanic of the Southern Indiana, with headquarters at Bedford, Ind., to succeed Mr. W. C. Walsh.

Mr. W. J. Tollerton, master mechanic of the Oregon Short Line at Pocatello, Idaho, has been appointed superintendent of motive power of the Southwestern and Choctaw districts of the Chicago, Rock Island & Pacific, with headquarters at Topeka, Kan.

Mr. Frank Huffsmith, superintendent of rolling stock and motive power of the International & Great Northern Railway, has resigned and the office is abolished. Mr. George R. Bunter, general foreman, has been apopinted master mechanic, and Mr. J. W. Buck, general storekeeper.

Mr. E. D. Bronner, recently appointed superintendent of motive power of the Lake Shore & Michigan Southern, has, at his own request, been transferred to his former position of superintendent of motive power and equipment on the Michigan Central. Owing to the illness of his daughter, Miss Harriett Bronner, he has been granted a leave of absence of six months. Mr. D. R. MacBain, recently appointed assistant superintendent of motive power, has been appointed acting superintendent of motive power during Mr. Bronner's absence.

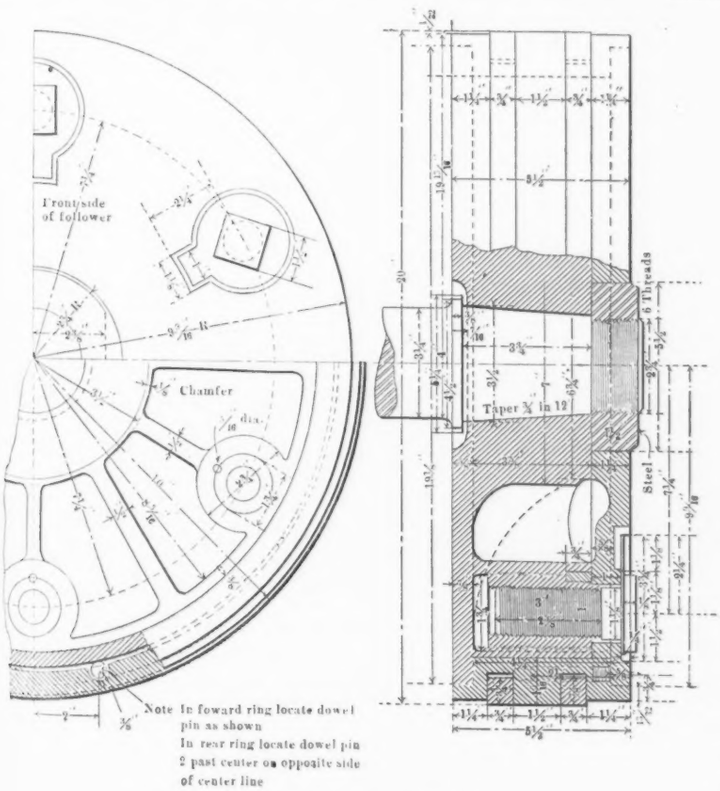
Mr. Le Grand Parish, who was recently appointed superintendent of motive power and equipment of the Michigan Central, has been transferred and appointed superintendent of motive power of the Lake Shore & Michigan Southern, the Lake Erie & Western, the Lake Erie, Alliance & Wheeling, the Dunkirk, Allegheny Valley & Pittsburgh, the Indiana Harbor and the Chicago, Indiana & Southern, with headquarters at Cleveland, Ohio. Mr. Parish was born at Friendship, N. Y. After leaving school he worked in several machine shops, after which he entered the laboratory of Thomas A. Edison. In 1889 he went with the Gilliland Electric Company at Adrian, Mich. In July, 1891, he entered the service of the Lake Shore & Michigan Southern Railway. From July, 1894, to November, 1896, he was chief clerk of the car department at Englewood, Ill., after which he was general foreman until November, 1899. He was then appointed master car builder of the Western division, and, in addition to this, he was, in 1900, made master car builder of the Michigan division. November 1, 1904, he was appointed assistant superintendent of motive power.

Mr. Michael Dunn, superintendent of motive power of the Southwest System, Pennsylvania Lines West of Pittsburgh, died recently at his home in Columbus, Ohio. Mr. Dunn was born January 25, 1857, at Lancaster, Pa. He graduated from Commercial College at Richmond, Ind., August, 1872, and entered railway service as a messenger on the Pittsburgh, Cincinnati & St. Louis Railway, now known as the Pittsburgh, Cincinnati, Chicago & St. Louis Railway (South-

west System, Pennsylvania Lines West of Pittsburgh), and remained with that road until his death. From August, 1872, until July, 1874, he served as a messenger at Richmond, Ind., after which he served as storekeeper until 1877 and then as shop clerk until September, 1878, when he was enrolled as machinist apprentice, serving in that capacity until 1882, and then as machinist until May, 1890. He was then appointed roundhouse foreman at Cincinnati, Ohio, and in February, 1891, was appointed general foreman at Cincinnati, and from September, 1893, to January, 1896, was road foreman of engines at the same place. In 1896 he was appointed master mechanic at Dennison, Ohio, and in March, 1903, master mechanic at Columbus, Ohio. He was appointed superintendent of motive power in August, 1903.

CAST STEEL PISTONS.

A correspondent has inquired concerning approved practice in the use of cast steel for locomotive pistons. The accompanying engraving illustrates a design which has been used for some time on the Chicago & Northwestern Railway, and has overcome the difficulty of breakage in pistons made of


Frontside of follower
Chamfer
Taper ¾ in 12
6 Threads
Steel
Note In foward ring locate dowel pin as shown
In rear ring locate dowel pin 2 past center on opposite side of center line

CAST STEEL PISTONS—C. & N. W RY.

cast iron. The follower bolts are screwed into brass bushings, which are themselves screwed into bosses in the spider, in order to prevent the sticking of the bolts in the cast steel spider. This drawing illustrates a bull ring piston, and it is likely to interest readers other than the correspondent referred to.

THE WORLD'S RECORD IN GUNNERY has been established on the battleship *Ohio* by D. M. Dean, whose score was thirteen bulls-eyes out of thirteen shots in one minute, with a 6-inch gun. The *Ohio* was steaming at 10 knots at the time, and the target was distant 1,600 yards. The best previous record for this size gun was eleven hits out of fourteen shots, made by one of the gun pointers in the British navy. When it is realized that as recently as the Spanish war the 6-inch guns, as fitted on the *Oregon*, were capable of only about two shots per minute, the importance of this record and the immense forward strides which it indicates become all the more apparent.—*International Marine Engineering.*

THE YOUNG MAN AND THE MOTIVE POWER DEPARTMENT.—The past has left us a somewhat unfortunate legacy, of which the result only needs attention on this occasion. The result referred to is seen in the tendency for young men to be easily enticed away from railroad service after they have spent years in preparation for it and are fairly on the road to win success. As a legacy of the earlier days of railroads in this country motive power positions are not, as a general rule, made sufficiently attractive. This, however, is to be changed, and the power to bring the change lies in the young men who now hold responsible motive power positions and in those who are to hold them in the near future. As motive power problems and possibilities become better appreciated and better understood, the railroads will surround motive power positions with greater attractions, which will eventually render it thoroughly worth while for the very best mechanical talent to prepare for work which, because of its attractions, will preserve this talent to the railroads. There are signs on the horizon to-day that this happy state is coming soon.—*Mr. G. M. Basford, at Purdue University.*

ENGINE HOUSE SMOKE JACKS.—Engine house smoke jacks should be fixed, the bottom opening should be not less than 42 ins. wide, and long enough to receive the smoke from the stack at its limiting positions, due to adjustment of the driving wheels, to bring the side rods in proper position for repairs. The bottom of the jack should be as low as the engines served will allow, and it should be furnished with a drip trough. The slope upward should be gradual to the flue; the size of the flue for the largest locomotives should not be less than 42 ins. in diameter; a damper should be provided in the flue—easily adjusted from the floor, and the material used should be non-combustible and non-corrosive.—*Committee report, American Railway Engineering and Maintenance of Way Association.*

VALUE OF TECHNICAL PAPERS.—The advancing foreman of to-day must be up to new ideas and keep moving; he has no time to sit with his hands folded. The proper use of mechanical literature is the foundation of success. The good, energetic mechanic waits hourly for his mechanical journal to arrive; how would our minds be enlightened if it were not for this? We would never have anything before us that would give us any reason to improve or make improvement. Every month there is something new that is very beneficial to the mechanic, and, I am sorry to say, there is not one-half of the mechanics reading these papers that should be. The country has produced some of the finest graduates in the mechanical line, and it is these who are worrying their minds about modern mechanics and improvements that when published are beneficial to you and me. I think if every foreman would stop long enough to think where he is in this hustling, modern, improved mechanical world, he would subscribe for more mechanical literature.—*G. W. Keller, before the Convention of the International Railway General Foremen's Association.*

BOOKS.

Transactions of the American Society of Mechanical Engineers. Vol. XXVI. 1905. 841 pages. Published by the Society, 12 West Thirty-first Street, New York City.

This volume contains the proceedings of the fiftieth meeting held in New York City, 1904, and the fifty-first meeting held in Scranton, Pa., 1905. The papers of special interest to motive power officials are: Fuel Consumption of Locomotives by G. R. Henderson, Road Tests of Brooks Passenger Locomotives by E. A. Hitchcock, Microstructive and Frictional Characteristics in Bearing Metal by Melvin Price.

CATALOGS.

IN WRITING FOR THESE CATALOGS PLEASE MENTION THIS PAPER.

SOME COMMENTS ON AIR BRAKE HOSE.—Under this title the Boston Belting Company, Boston, Mass., has issued a small pamphlet directing attention to certain pertinent facts, as indicated by a careful study of the tests reported at the recent convention of the Master Car Builders' Association by the committee on air brake hose specifications.

GASOLINE ELECTRIC MOTOR CAR.—William B. Strang, 15 Wall Street, New York City, has issued a pamphlet entitled "Success of the Strang Gas-Electric Railway Car System." It describes the results which have been gained in service from the car "Ogerita," which was described on page 103 of our March, 1906, issue.

MOTORS.—The Crocker-Wheeler Company, Ampere, N. J., is sending out bulletin No. 66, which describes their new type W motors. These were designed primarily for use in rolling mills and are of great mechanical strength, have sealed bearings, excluding all dirt, and are fireproof. They are arranged for outputs of 25, 50, 75 and 100 h. p., and are designed for 220 volts only.

WOODWORKING MACHINERY.—A handsomely illustrated 200-page catalog has been issued by the S. A. Woods Machine Company, Boston, Mass., describing the line of woodworking tools made by them. These include heavy timber sizers and matchers; fast feed planers and matchers; flooring machines; double surface planers; moulders, inside, outside and variety; automatic railway cut-off saw; lock corner box machines; automatic knife grinder; hollow chisel mortisers and universal boring attachments.

OIL TANKS AND CABINETS.—We have received from S. F. Bowser & Company, Fort Wayne, Ind., copies of the 14th edition of catalog No. 1, concerning the Bowser self-measuring and computing oil outfits, and of the 5th edition of catalog No. 3, which describes the Bowser self-measuring factory, railroad and navy oil tanks and cabinets. These outfits are furnished in any desired size to handle oils of all kinds, and may be arranged to suit almost any conditions. They are very completely described in these two catalogs.

FLEXIBLE STAYBOLTS.—The Flannery Bolt Company, Pittsburgh, Pa., is sending out a small pamphlet entitled "A Few Installations of the Tate Flexible Staybolt." It contains a number of interesting views showing applications of these staybolts to different types of locomotive boilers. Special attention is directed to the importance of providing the proper tools for the application of these bolts. A pamphlet describing the tools to be used for this purpose, and containing instruction for applying the Tate Flexible Staybolt, will be furnished upon application.

KEY-SEAT MILLING MACHINES.—Catalog No. 44 from the Newton Machine Tool Works, 24th and Vine Streets, Philadelphia, Pa., describes several types of key-seat milling machines made by them. One of these is for rapidly milling key-seats for feather keys, short splines and other work requiring one or both ends rounded up. The machine has both a horizontal and vertical spindle, and is built in two sizes. A machine is also shown for milling the two key-seats in locomotive axles accurately and at the same time.

ABUSES OF VALVES.—In an article on the "Abuse of Valves," published in *The Valve World*, Mr. R. T. Crane, president of Crane Co., says that in ninety-five cases out of a hundred leaky valves are due to abuse and carelessness on the part of the men who install them, rather than the defects in the valves themselves. If the few simple directions given by Mr. Crane for the installation and care of valves were generally followed much of the annoyance and expense due to leaky valves would be avoided. The article has been reprinted in the form of a poster suitable for hanging on the walls of engine rooms and shops, and all users of valves may obtain one or more copies free by writing Crane Co., Chicago. The posters are legibly printed in two colors on heavy calendered bristolboard.

LARGE STEAM AND ELECTRIC LOCOMOTIVES.—The American Locomotive Company, in a pamphlet just issued, presents a paper on this subject read before the New York Railroad Club by Mr. J. E. Muhlfeld, general superintendent of motive power of the Baltimore & Ohio Railroad. Extracts from the discussion of the paper are also reproduced. The paper opens with a description of the electric locomotive No. 7-8, built by the General Electric Company, giving details of its design and record of its performance since going into service in 1903 and statistics of the average cost of operation and maintenance per hundred miles run. Then follow several specifications of the requirements an electrical locomotive and its source of power should fulfil to produce efficiency and economy in railroad service. The next seven or eight pages are taken up with a description of the Mallet articulated compound, built by the American Locomotive Company, giving special features of design, and comparing it as to total weight, tractive power and hauling capacity with two consolidation locomotives which together were formerly required to do the work now done by the Mallet. Then follows a record of the performance of this locomotive for a period of one year—from January, 1905, to January, 1906—and a report as to the general condition of the machinery and boiler at the end of this time. Mr. Muhlfeld mentions some of the results obtained from this type of steam locomotive which cannot be duplicated by other single units of steam, electric or internal combustion locomotives in use on American railroads to-day, and gives a short resume of the requirements modern railroad motive power must fulfil. Following this is a statement of the equipment necessitated by the use of electricity for motive power, and that required where the steam locomotive is used. In the last three or four pages of the paper, the possibilities for electrification which some mountainous steam railroads present are pointed out, followed by a general discussion of the subject of steam versus electricity for motive power. Mr. Muhlfeld compares the electric and steam locomotive from the standpoints of efficient and economical operation and maintenance, pointing out the necessity of reducing the initial cost of electrification by increasing the efficiency and economy of present types of the stationary boiler and by improvements in the means of generating, distributing, converting and transmitting electrical current. In conclusion the author says that it is only by the harmonious co-operation of the electrical and mechanical engineer attacking the problem from the transportation and motive power standpoints, that we can hope to meet the present and future motive power requirements. The rest of the pamphlet is taken up with discussions of the paper by Mr. F. J. Cole, Mr. H. H. Vaughan of the Canadian Pacific Railway, Mr. W. B. Potter of the General Electric Company, Mr. Angus Sinclair and Mr. W. M. Smith, closing with a summing up by Mr. Muhlfeld.

NOTES.

PRESSED STEEL CAR COMPANY.—The office of this company in Mexico City has been changed from Calle de Gante No. 8 to Prolongacion del 5 de Mayo No. 9.

QUINCY, MANCHESTER, SARGENT COMPANY.—This company of Chicago announces the opening of its Priest snow flanger department. A large number of orders have already been booked, including 22 for Canada.

NORTON COMPANY.—Mrs. Frances A. W. McIntosh, formerly advertising manager of the Standard Tool Company, Cleveland, Ohio, and more recently connected with the advertising department of *Power*, New York, has taken charge of the publicity department of the Norton Company, Worcester, Mass.

CROCKER-WHEELER COMPANY.—This company has completed arrangements and opened an office and warehouse at No. 208 First Street, near Howard, San Francisco, Cal., with Mr. H. C. Baker as local manager. It has also opened an office at No. 447 Pacific Electric Bldg., Los Angeles, Cal., with Mr. L. Cummins as representative, and is arranging to establish an office in Seattle, Washington, in the near future.

ENGINEERING OPPORTUNITIES IN THE PHILIPPINES.—It has been announced that there will be a number of engineering vacancies in the Philippine service within the next few months, and that it is expected that an examination for these openings will be announced in a short time. The acting chief of this bureau is Frank McIntyre, Captain of the 19th U. S. Infantry, to whom requests for information can be addressed at the Bureau of Insular Affairs, War Department, Washington, D. C.

LOCOMOTIVE APPLIANCE COMPANY.—At the annual meeting of the stockholders of the Locomotive Appliance Company, which was held at their offices, Old Colony Building, Chicago, Ill., August 9, 1906, the following directors were elected for the ensuing year: Mr. Frank W. Furry, Mr. J. J. McCarthy, Mr. J. B. Allfree, Mr. Willis C. Squire, Mr. Ira C. Hubbell, Chicago, Ill.; Mr. Clarence H. Howard, Mr. H. M. Pflager, Mr. B. F. Hobart, Mr. C. A. Thompson, Mr. W. J. McBride, St. Louis, Mo.; Mr. J. H. McConnell, Pittsburgh, Pa.